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Examining the Relationships between Metacognition, Self-regulation and Critical Thinking in Online Socratic Seminars for High School Social Studies Students

Dissertation

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Examining the Relationships between Metacognition, Self-regulation and Critical Thinking in Online Socratic Seminars for High School Social Studies Students

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Dedication

To my dearest parents and

my beloved husband

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Examining the Relationships between Metacognition, Self-regulation and Critical Thinking in Online Socratic Seminars for High School Social Studies Students

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This study examined the relationships between metacognition, self-regulation and students' critical thinking skills and disposition in online Socratic Seminars for ninth grade World Geography and Culture students. Participants of this study came from six intact pre-AP (Pre-Advanced Placement) classes in a public high school in south central Texas in the United States. They were randomly assigned to two groups: a three class treatment group and a three class comparison group. Students in both groups received training on critical thinking skills, Internet security, "netiquette" and the technological tools involved in the online Socratic Seminars. The experimental group performed two metacognitive tasks. They assigned critical thinking tags in the discussion forum and wrote two structured reflection journals after they finished each of the two Socratic Seminar discussions, while the comparison group performed neither of the two metacognitive tasks. Both quantitative and qualitative data were collected for the data

analysis. A multivariate analysis of covariance (MANCOVA) showed statistically significant effects of the two metacognitive tasks on students' self-regulation, but not on their critical thinking skills and disposition. The structure equation modeling analysis showed that self-regulation had significant relationships with students' critical thinking disposition, but not with students' critical thinking skills for both the experimental and the comparison groups. The structural equation modeling analysis also revealed an insignificant moderating effect of performing the two metacognitive tasks on the relationship between self-regulation and students' critical thinking. Qualitative data analysis triangulated results from the quantitative analyses.

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Chapter I: INTRODUCTION

BACKGROUND

From Socrates' Socratic Seminars to Dewey's (1933) inquiry learning to studies of online Socratic Seminars (Jewell, 2005; Polite & Adams, 1996; Tredway, 1995; Walters, 2003), critical thinking has been one of the most discussed learning goals in school settings, either traditional or virtual. The real challenge is to find a way to enhance critical thinking in educational settings (Wyre, 2007). Because of current educational assessment approaches, crucial skills required for life after school are usually not assessed in standardized tests and, therefore, are rarely included in the education of many students (Neill, 2003). In a study of students' perception of their school experience among over 10,000 high school students in the United States, 41 % of the participants considered their educations deficient in teaching essential life skills and over one-third of participants expressed that the school-based development of critical thinking skills lay in the fair to poor range (National Governors Association, 2005).

Among the list of crucial skills for life after school, "the ability to reason informally; to monitor one's own thinking, analyze arguments, distinguish between correlation and causality; identify stereotypes and bias; and to make decision based on evidence are especially important" (Burkhart, 2006, p. 3). As students between ages 14-18 grow up amid abundant technology, they are inundated with information and media resources almost every day. Being able to collect information from the pool of databases and the Internet is no longer enough; it is more critical that students have the essential training and practices to evaluate the validity of the information they received online with

unbiased reasoning. Most importantly, they need to be able to think critically when dealing with large amounts of information of mixed quality available online (Burkhart, 2006; Lee, 2004).

In order to enhance critical thinking among students, it is necessary to first understand what it means. In the previous literature, there have been various efforts to define the construct (Facione, 1990; Vanderstoep & Pintrich, 2003). Although slightly different, most of the definitions of critical thinking corroborate that critical thinking is composed of both critical thinking skills and critical thinking disposition (Lee, 2004). Experts in Facione's (1990) Delphi study agreed that critical thinking skills should "be purposeful, self-regulated judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (p. 23). They defined critical thinking dispositions as the will to apply critical thinking skills (Facione, 2007; Facione, Facione, & Giancarlo, 1996, 2000).

Although critical thinking has been described as a desirable proficiency, there have only been sporadic studies on its inclusion in curriculum (Pellegrino, 2007), and most of the previous studies are at the higher education level (Burkhart, 2006; Chau, Chang, Lee, Ip, Lee, & Wootton, 2001; Halpern, 1989; Ennis, 1996; Lee, 2004; McDade, 1995; Shin, 2002; Thayer, 2006; Wyre, 2007). Among them, several studies focused on various instructional strategies to promote students' critical thinking, such as using videotape vignettes (Chau et al., 2001), media literacy (Thayer, 2006), explicit instruction (Burkhart, 2006), or case study analyses (Lee, 2004; McDade, 1995); others reported metacognition as an efficient instructional strategy to promote critical thinking (Shin,

2002; Wyre, 2007). In a study on how metacognition along with epistemology maturation affected community college students' critical thinking, Wyre (2007) reported that metacognitive enrichment could significantly increase students' personal epistemology and, thereby, enhance their critical thinking skills. Another study by Shin (2002) used a metacognitive art criticism teaching strategy in a high school art program. His study reported that metacognitive knowledge and strategies were beneficial when students critiqued, wrote and revised critical essays about works of art. While these research results showed that metacognitive skills are valuable and teachable to students and that they foster critical thinking--most teachers know little about how to include metacognitive skills in course curricula (Pellegrino, 2007).

According to the Center of Civic Education (1994) and the Geography Education Standards Project (1994), the goal of social studies is to promote the development of competent citizens who have necessary critical thinking skills to function in a democratic society. Although many scholars acknowledge the significance of promoting critical thinking skills among students (Anderson & Garrison, 1995; Garrison, Anderson & Archer, 2001; Garrison & Cleveland-Innes, 2004, 2005), very few studies have investigated how instructional strategies can effectively enhance critical thinking among high school students, especially in social studies. In addition, most studies investigating students' development of critical thinking focused only on higher education or professional development programs (Anderson & Garrison, 1995; Garrison & Cleveland-Innes, 2004, 2005; Yang, Newby, & Bill, 2005). Research at the high school level has been largely neglected.

Concerning the significance of fostering critical thinking among high school students while meeting the technological standards of this century at the same time, the 2002 study by the International Society of Technology Education (ISTE) reported a lack of current technological preparation among high school students. The study argued that teachers must be prepared to provide their students with technology-supported learning opportunities, and it proposed a new learning environment where students are empowered with the advantages of technology to apply strategies for solving problems, and to use appropriate technological tools for learning, collaborating, and communicating in both real and virtual settings. In the traditional learning environment, the focus is often on teacher centered instruction where students receive information passively, while in the online learning environment, students have more autonomy to engage in collaborative work, inquiry-based learning and critical thinking (ISTE, 2002). ISTE (2002) proposed a set of competencies and described the profile for a technology-literate student as someone who has the ability to "identify capabilities and limitations of contemporary and emerging technology resources and assess the potential of these systems and services to address personal lifelong learning and services" (p. 7). The list of competencies calls for higher level thinking skills, especially critical thinking, to manage the colossal amount of available technological resources and information.

In a longitudinal study at preschool, high school and higher education levels, Cuban (1998, 2003) found the proportion is not balanced between available technologies and the expected changes in teachers' teaching styles. He reported that the exact application of computer technologies to revolutionize teaching and learning rarely occurred although these are the changes technologies are supposed to help make happen.

His study result showed that teachers in current society still failed in taking full advantage of technologies despite the fact that every year schools spent a considerable proportion of their budgets on computer technologies. If lacking technological resources is no longer the problem that caused school curricula to fall short of meeting the demands of current society, the emerging need is to design sound instructional strategies in a technology-supported environment to bring desirable changes.

Several studies in previous literature have shown that online Socratic seminars are conducive to students' metacognition for several reasons. First, the social environment in online learning communities provides learners opportunities to test their metacognition and at the same time provides them with feedback and models from peer interactions. It sustains learners' metacognition by supporting the feedback loop of giving and receiving feedback (Polite & Adams, 1996). In the traditional classroom setting where peer-to-peer or student-to-teacher interaction occurs synchronously, students have fewer opportunities to engage in any reflective activities due to the lack of supporting environment. In addition, tight class schedules usually do not leave room for students to contemplate their own thinking. On the other hand, in online Socratic seminars, students are offered the option to interact asynchronously, which gives them more time to reflect on their learning (Walters, 2003). Also, the initiation of metacognition usually occurs when a person is alone and in a private place. Although the online environment can be public, not being able to see the audiences usually releases students' anxieties of presenting their thinking in front of others (Tu, 2002). If teachers make metacognitive tasks the obvious learning goal for the whole class and design instructional activities to encourage students' self-reflection, students will not only have enough support to improve their learning, but also

have more opportunities to form the habit of constantly pondering their thinking (Paris & Winograd, 1990).

This research project derived from the need and suggestions reported in previous literature to investigate design and effects of metacognitive instructional strategies to develop critical thinking in a computer supported environment, specifically in online Socratic seminars for high school students. This study followed the framework of Facione's critical thinking skills and disposition (1990) because of its concrete outline of sub-skills involved and its applicability to the research context of this study. To investigate the design and implementation of effective metacognitive instructional strategies in school curricula and determine how these can improve students' critical thinking skills, this study examined the design of two metacognitive tasks, critical thinking tags and reflection journals, to scaffold students' metacognition and possibly effect students' development of critical thinking. Previous studies have shown that applying thinking tags (Scardamalia & Bereiter, 1996; Cho & Jonassen, 2002; Schellens, et al., 2009) and writing reflection journals (Simpson & Courtney, 2007) could be effective instructional approaches to develop students' critical thinking. The purpose of the two metacognitive tasks is to make both critical thinking and metacognition clear instructional goals for the students and to support these two learning goals in a social and technology-supported environment. Based on Dewey's (1933) notion of critical thinking, the ability to notice problems for future inquiry is the first step of anyone's critical thinking. By making both critical thinking and metacognition obvious learning goals for students, students are encouraged to detect deficiencies in their thinking process through self-reflection or through others' feedback. When students pay more attention to

reflection journals on their critical thinking, they become more aware of their critical thinking processes and develop new approaches to improve their own critical thinking.

The close relationships between metacognition, self-regulation and critical thinking has been studies in the existing literature, such as Willingham's (2008) studies on the relationship between metacognition and critical thinking, Facione's (1990, 1996, 200, 2007) studies on the relationship between self-regulation and critical thinking, or Zimmerman's (1994, 1995) studies on the relationship between metacognition and self-regulation. However, none of the previous studies examined the three constructs together in the same study. Because of the close relationships among these three constructs and because of the void in the existing literature to investigate them integratively in the same study, this study also analyzed relationships among them in order to create a model delineating their relationships to each other in both the comparison and the experimental group.

RESEARCH QUESTIONS

The purpose of this study is threefold. First, this study addressed effects of performing the two metacognitive tasks on students' self-regulation and critical thinking. The effects were investigated through examining mean differences and any structural variance caused by performing the two metacognitive tasks. Second, this study investigated the relationships between self-regulation, critical thinking skills and critical thinking disposition in both the experimental and comparison groups. Because of the close relationships reported in the existing literature, the researcher aimed to create a model delineating their relationships integratively in a structural equation model. The third aspect of this research focused on the deployment of the two metacognitive tasks,

and the teacher and students' perception of them in online Socratic seminars. Findings from the third portion of this research should provide thoughts for future improvements on the design of the two metacognitive tasks to scaffold students' critical thinking and self-regulation. This research answered the following set of research questions:

Question 1. What are the effects of an intervention that involved metacognitive tasks on mean scores of students' critical thinking skills, critical thinking disposition or self-regulation in online Socratic seminars for high school social studies classes?

Question 2. Does an intervention that involved metacognitive tasks introduce any structural differences in the relationships among self-regulation, students' critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes? If so, in what way?

Question 3. What are the relationships among self-regulation, students' critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes?

Question 4. How do the teacher and students perceive the implementation and usefulness of an intervention that involved metacognitive tasks?

SIGNIFICANCE OF THE STUDY

This study contributed to the existing literature in three ways. First, it explored the instructional potential of two metacognitive tasks (reflection journal and applying critical thinking tags in online discussions) to promote students' self-regulation, critical

thinking disposition and critical thinking skills. Second, it investigated the relationships and created a model that delineates the relationships among self-regulation, critical thinking skills and critical thinking dispositions. Third, it examined the design and implementation of the two metacognitive tasks and suggested future improvement. Fourth, it investigated the students' and teacher's perception on the usefulness and the actual implementation of the two metacognitive tasks. Because no previous study focused on these three aspects, this study extended the existing literature in these perspectives.

CONCLUSION

This study followed the conceptual framework among metacognitive, self-regulation and critical thinking as listed below. The figure below shows the hypothesized relationships between metacognition, self-regulation and critical thinking. Metacognition is hypothesized to have a significant direct effect on self-regulation and critical thinking as well as a significant moderating effect on the relationship between self-regulation and critical thinking. Self-regulation is also hypothesized to have significant relationship with critical thinking.

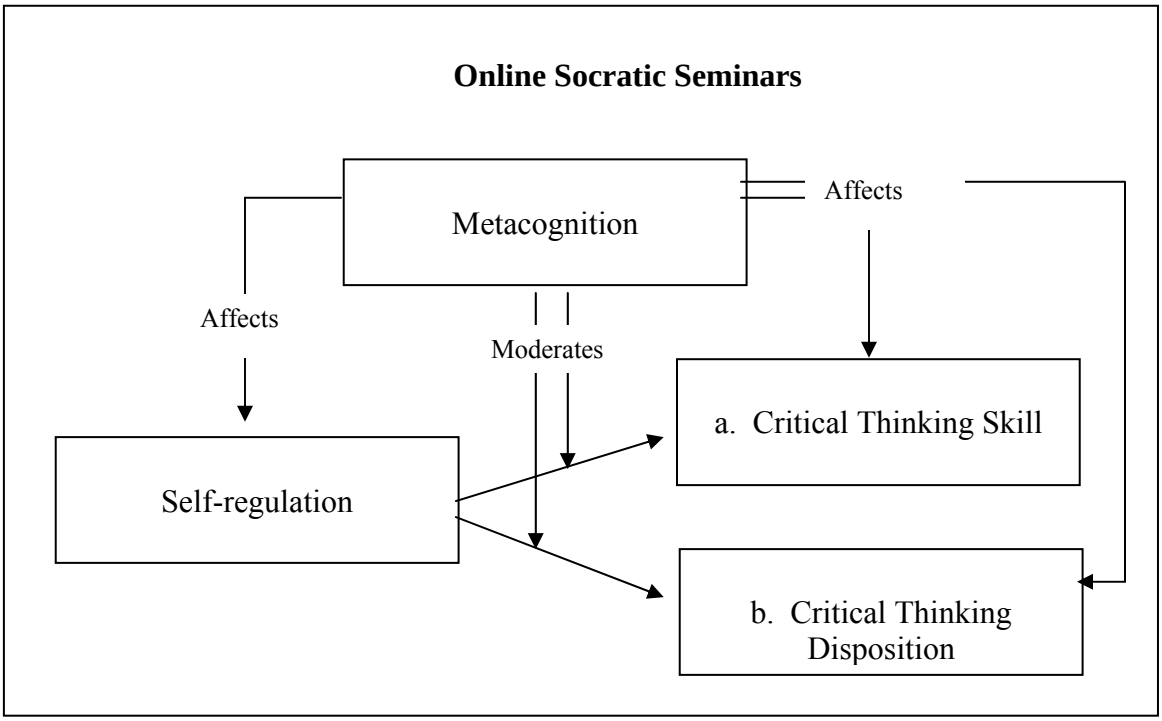


Figure 1. Conceptual flow chart of the relationship between metacognition, self-regulation, and critical thinking

Chapter II: REVIEW OF THE LITERATURE

Research has shown that metacognition is one of the strongest predictors of critical thinking (Ingle, 2007). Metacognition involves a learner's ability to reflect or think about his or her learning. Metacognition is crucial to an individual's development of critical thinking because metacognition provides impetus to improve one's critical thinking and facilitates one's critical thinking (Corliss, 2005; Davison and Sternberg, 1998; Dominowski, 1998). The control and monitoring aspect of metacognition help learners make adjustments in plans and strategies accordingly during the critical thinking process (Corliss, 2005). This self-generated feedback along with external feedbacks from the environment provides essential information to help an individual regulate his or her learning goals and activities (Pellegrino, 2007). In this section, the discussion begins with online Socratic seminars that provide the environment that supports external metacognitive feedback and encourages self reflection. The second section discusses critical thinking and its two sub components: critical thinking skills and critical thinking disposition. The third section examines metacognition and self-regulation, and their relationships to critical thinking. The last section summarizes the relationships among online Socratic seminars, metacognition, self-regulation and critical thinking.

ONLINE SOCRATIC SEMINARS

The learning context of this research, online Socratic seminars, is based on assumptions of Constructivist theory, which holds that learning should be a social and self-directed process. In this type of learning context, students have control over their

learning through social interactions with others. In online Socratic seminars, people learn and grow by sharing knowledge and exchanging ideas. In this type of learning environment, knowledge is distributed across both time and space (Na Ubon & Kimble, 2002). It is transformed from an individual to a collective dimension and from the tacit to explicit form, which can only be done by creating opportunities for people to engage in face-to-face, group or other social activities (Nonaka & Takeuchi, 1995). It is in social occasions, such as online Socratic seminars, that people are most likely to talk, discuss, and convert their tacit knowledge into overt knowledge.

Traditional schools are currently facing various major challenges to prepare their graduates to become good citizens and competent employees (Bateman, 1998). The first challenge regards students' future careers. Based on his study on high school graduates, Bruer (1993) found that high school graduates have been determined to lack communication, collaboration, comprehension, and reasoning skills, which are essential skills for the job market. The second challenge is in regard to deficiencies in students' developmental needs, which include the needs for social acceptance, autonomy, self-efficacy and peer relations (Harter, 1981). The lack of fulfillment of those needs can lead adolescents to lose intrinsic motivation, become apathetic, lack confidence, decline in attitudes toward school and schoolwork, and form a lower self-concept of academic abilities (Harter, 1981). In order to meet the above-mentioned challenges, it is imperative to supplement the traditional classroom environment with an online environment where students can fulfill these needs (Bateman, 1998; Sarason, 1974).

Although technology nowadays can support collaborative work and interaction among members in an online environment where knowledge creation and sharing are

supposed to take place, Davenport and Prusak (2000) argue that the installation of the Internet or pieces of software will not in themselves bring about the desired learning outcomes. They maintained that technology alone will not ensure social interactions happen because the mere presence of technology may not create a learning environment where members are willing to devote cognitive and social efforts. Polite and Adams (1996) suggested that a major function of online Socratic seminars is to negotiate meaning through which learners have opportunities and practices to expand upon their existing repertoires of knowledge. While technology is making larger amounts of information available to students, online Socratic seminars can provide an environment where knowledge is open and flows freely among members.

Cognitive Presence, Teacher Presence, and Social Presence

Garrison and Cleveland-Innes (2005) equate cognitive presence with what they considered a deep learning approach. They differentiate deep learning from two other types of learning approaches that are typical in online learning environments: surface and achievement learning approaches. They argue that "in a deep approach to learning, material is embraced and digested in the search for meaning" (p. 137), while in superficial or achievement learning approaches, learning is either embraced with the least effort or driven by external rewards. In deep learning, learners constantly reflect on their learning approaches and adjust them accordingly. Garrison and Cleveland-Innes (2005) argue that social interactions are not equal to the presence of cognitive efforts from participants. Students may have many interactions with others, but their interactions are not necessarily about academically related issues. They suggest that the

challenge in designing and facilitating a community of inquiry is to scaffold a learning experience of cognitive presence. They argue that the reflective and collaborative property of asynchronous, text-based online learning can efficiently promote deep learning in communities of inquiry. In order to develop life-long learners, the challenge is to scaffold a meaningful discourse through which learners are provided with opportunities to reflect on their discourse as well as manage and monitor their learning through metacognitive awareness (Garrison, 2002).

Another study by Garrison and Cleveland-Innes (2004) found that students' greatest adjustment when participating in online learning is most directly influenced by issues of social and cognitive interactions. They suggested that peer interaction contributes to most social presence, and that teaching presence is crucial to supporting higher order thinking among participants. They determined that deep learning requires both structure and leadership from the teacher and social interactions among participants in an online learning environment. Teaching presence, which provides more structure and guidance to online discussions, has been shown to have a great impact on the quality of online discussions (Wu & Hiltz, 2004). Without facilitation or modeling from the instructors, students' interaction can easily fall into a mere exchange of personal experiences or arguments without well-supported reasoning (Angeli, Valanides, & Bonk, 2003). When teacher facilitation is missing, students' online discourse could become a series of monologues (Pawan et al., 2003). Students can share their personal opinions or thoughts, but fail to exchange or connect their own ideas with others. Without the teaching presence to sustain students' engagement and metacognitive awareness, the community of inquiry can easily lose its dynamics.

Similarly, meaningful exchanges of ideas require cognitive efforts and social presence to sustain the momentum of the community (Garrison & Cleveland-Innes, 2005). Because the final goal of deep learning is to help transform students' learning from exploration to integration and then to resolution (Garrison & Anderson, 2003), any online learning of inquiry require social, cognitive and teaching presence to achieve this goal (Garrison & Cleveland-Innes, 2005). When an online learning environment demonstrates social, cognitive and teaching presence, they provide learners with a supportive environment to practice metacognitive awareness and constantly test their adjusted learning strategies based on self-reflection and feedbacks from others. Because of the supportive environment, students can more effectively process internal and external feedback to improve their cognitive skills, such as critical thinking.

CRITICAL THINKING

The following section discusses critical thinking including both critical thinking skills and critical thinking disposition. Critical thinking skills include a set of higher level cognitive skills, while critical thinking disposition refers to characteristics and motivations of a critical thinker. Many researchers have proposed the significance of critical thinking development among students. McPeck (1981) argued that critical thinking is essential to any education. It is also essential outside of the classroom because it is one of the fundamental features of a "developed person" (Brookfield, 1989). Brookfield (1989) argued that a developed person should have the ability to think critically, which is crucial "to understand personal relationships, envisioning alternatives

and more productive ways of organizing the workplace and becoming more politically literate" (p. 14).

Definition of Critical Thinking Skills

Several pieces of literature report various efforts to understand critical thinking skills (Erwin, 1998; Facione, 1990, Van Gelder, Bissett, & Cumming, 2004; Vanderstoep & Pintrich, 2003). One group of scholars considered critical thinking skills as equivalent to problem solving skills (Garrison, 1991). According to Garrison (1991), critical thinking encompasses problem solving and creative thinking, which develops and transfers school education to practical life experiences. He proposed a model of critical thinking that includes five problem-solving phases: problem identification, problem definition, exploration, application and integration. Corroborating with Garrison's definitions, Erwin (1998) equated critical thinking to problem solving in real life situations. He argued that even though critical thinking and problem solving are two distinct constructs, they overlap in many aspects, especially in regard to processes to find solutions for open-ended problems in our daily lives. He considered problem solving as "a step-by-step process of defining the problem, searching for information, and testing hypotheses with the understanding that there are a limited number of solutions" (p. 1), while he defined critical thinking as a broader term, which "involves constructing the situation and supporting the reasoning behind a solution." (p1). Another similar definition considered critical thinking a broader problem solving process. Vanderstoep and Pintrich (2003) defined critical thinking as "the ability to use acquired knowledge in flexible and meaningful ways, through understanding the problem or issue, evaluating

evidence, considering multiple perspectives, and taking a position" (p. 275). Anderson and Garrison (1995) posited that when applied to thinking, the term "critical" implies a necessity to sort through the underlying premises of statement of facts, deductions, opinions and hypotheses. Based on their definition, critical thinking refers to "a process comprised of both individual internal activities and social or external activities" (Anderson & Garrison, 1995, p. 187). They considered critical thinking the integration of thought and action and posited that action is most often realized through critical discourse, especially in the educational context.

Another group of scholars, such as the panel experts in Facione's (1990) Delphi study, defines critical thinking as "the process of purposeful, self-regulated judgment." They described critical thinking as a process that reasons consideration about evidence, context, conceptualizations, methods, and criteria. They concluded that

> We understand critical thinking to be purposeful, self-regulator judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon, which that judgment is based. (p. 23)

Based on their definition, critical thinking should involve a set of six critical cognitive skills: analysis, interpretation, inference, explanation, self-regulation and evaluation. The figure below represents these six cognitive skills.

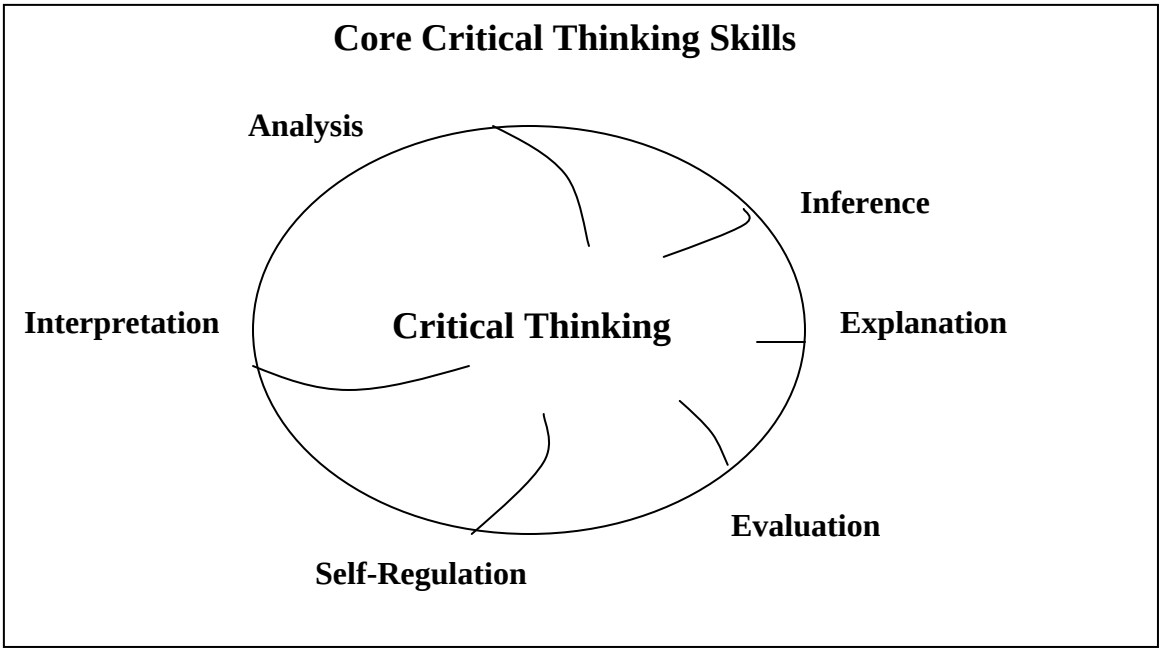


Figure 2. Core Critical Thinking Skills (Facione, 2007, p. 5)

According to Facione (1992), interpretation involves a set of sub skills, including categorization, decoding significance and clarifying meaning. It refers to someone's efforts to express the meaning or significance of things, such as the individual's experiences, beliefs or judgments (e.g., the skill to identify an author's purpose based on previous readings or on the author's autobiography. The second skill, analysis, is to "identify the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions" (p. 5). An example of analysis is the cognitive skill to identify similarities and differences between two approaches to a solution. The third skill, evaluation, is to "assess the credibility of statements or other

representations, which are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation" (p. 5). An individual usually applies this skill in conjunction with the other skills (e.g., analyzing the proposed solution in detail before he or she can evaluate the soundness of that chosen solution). The fourth skill, inference, means to "identify and secure elements needed to draw reasonable conclusions, to form conjectures and hypotheses, to consider relevant information and to deduce the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation" (p. 5). For example, a student uses inference when he or she predicts consequences of a proposed solution before he or she decides that it is the most feasible among all the potential plans. The fifth skill, explanation, is defined as "being able to present in a cogent and coherent way the results of one's reasoning" (p. 6). For example, a student uses explanation when he or she elaborates to his or her peers all the possible causes of a social issue. This skill is especially important in an online learning environment where learning depends heavily on written or verbal communication. An individual must have good explanatory skills to make his points clear to others and to help others understand the issues of significance. The sixth skill, self-regulation, constantly adjusts the other 5 sub-critical thinking skills based on inner feedbacks from self-reflection and external feedbacks from the outside environment. Self-regulation provides learners with a tool to constantly adjust and improve their critical thinking skills. It is referred to as the skill to "consciously monitor

one's cognitive activities, the elements used in those activities, and the results deduced" (p. 7).

Based on the definitions by experts in Facione's (1990) Delphi report, critical thinking involves a recursive self-regulated process when an individual applies higher level cognitive skills to make sound judgments. It is a tool of inquiry and involves iterative adjustments through metacognition (Lee, 2004). Various definitions of critical thinking imply the use of metacognition as the imperative to any problem solving activities (Corliss, 2005). According to Duphorn (2005), critical thinking is a "reflective, non-linear process that involves praxis of thought and action" (p. 40). Barnett (1997) further added the concept of "critical being" to descriptions of a critical thinker. He argued that a critical being is someone who critically engages in worldly issues as well as develops critical self-reflection and puts critical thoughts into action. Garrison (2002) also proposed to include dimensions of reflection to definitions of higher order thinking, such as critical thinking.

Definition of Critical Thinking Dispositions

Another component of critical thinking, critical thinking disposition, refers to human attributes that include "inquisitiveness, open-mindedness, systematicity, analyticity, truth-seeking, CT self-confidence, and maturity" (Facione, 2007, p. 10). Experts in Facione's (1990) Delphi study described a critical thinker as someone who is

> habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results, which are as precise as the subject and the circumstances of inquiry permit. (p. 9)

Based on their definitions, critical thinking disposition involves a set of seven human traits. The graph below depicts the seven human traits comprising critical thinking disposition.

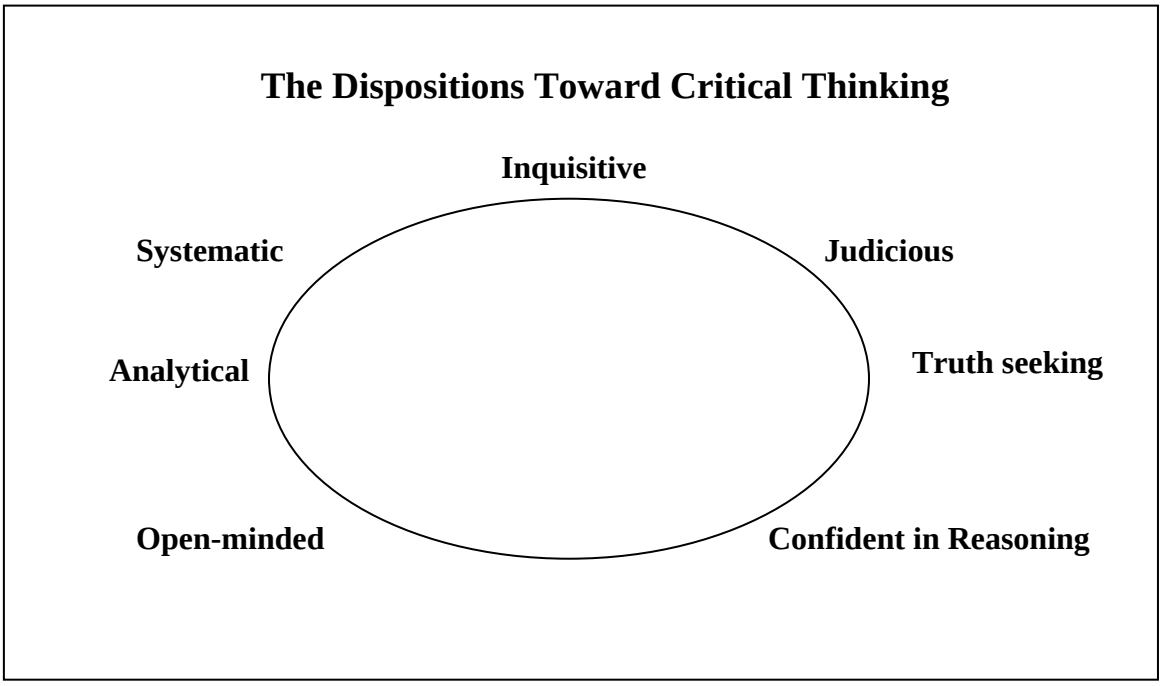


Figure 3. Core Critical Thinking Dispositions (Facione, 2000, p. 23)

Critical thinking disposition is the will to exercise critical thinking skills. Without critical thinking dispositions, an individual will not necessarily use his or her critical thinking skill unless he or she is disposed to do so (Facione, 2007).

Critical Thinking as a Whole

Critical thinking includes both critical thinking skill and critical thinking disposition (Facione, 1994). Critical thinking skills are higher level cognitive strategies to help a person in the inquiry process, while critical thinking disposition provides one with the will and motivation to apply these cognitive skills; both are equally important to developing citizens with useful and objective insights about national issues (Facione, 2007). Several studies have shown that metacognition can be one effective approach to develop critical thinking among students (Brookfield, 1989; Dewey, 1933; Garrison, 2002). The next section will discuss metacognition and its relationship with critical thinking in detail.

METACOGNITION

There have been several different attempts in the research literature to define the construct of metacognition (Flavell, 1979; Garrison, 1997; Paris & Winograd, 1990; Swanson, 1990; Schraw, 2001). It is defined as "the knowledge and control one has over his or her thinking and learning activities" (Swanson, 1990, p. 306). A general consensus is that "metacognition includes both knowledge of one's knowledge, processes, cognitive and affective states, and the ability to consciously and deliberately monitor and regulate one's knowledge, process, and cognitive and affective states" (Hacker, 1998, p. 11).

Favell (1997) further delineates the sub-components involved in a metacognitive activity. According to Flavell's (1979) definition, "metacognitive experiences are any conscious cognitive or affective experiences that accompany and pertain to any intellectual enterprise" (p. 906). His model of metacognition illustrates the interactions among four classes of factors: metacognitve knowledge, metacognitive experiences,

goals/tasks and actions/strategies. The first factor, metacognitive knowledge, involves three factors and their interactions. The factors include: person, task and strategy. For example, when a student exerts metacognitive knowledge when solving an open ended question, he or she will need to know information about himself or herself, the learning task and the strategies that can help him or her successfully accomplish the task. He or she needs to know his or her current knowledge about the problem compared to the amount of knowledge needed to solve it. Also, he or she must understand the nature of the problem and the hidden implications. Finally, he or she needs to examine his or her repertoire of existing strategies to help him/her solve the problem. The second factor, the metacognitive experiences, concern self, tasks, goals and strategies that help learners to interpret the meaning and behavior of future metacognitive experiences. They not only have effects on cognitive goals/tasks, metacognitive knowledge and cognitive actions/strategies, but they also serve several functions including leading a person to establish new goals and revise or abandon old ones, affecting metacognitive knowledge by adding to it, deleting from it or revising it and activating strategies at the cognitive and metacognitive levels. The third factor, goals/tasks, refers to the learning tasks/goals either generated by the learner himself or herself or by external forces. For example, a novice student who is interested in an open-ended question about civics might attempt to understand it by applying various learning strategies, such as comparing similar issues in human history or reading relevant articles online. The last factor, actions/strategies, involves both the existing and the new strategies/actions an individual needs in any learning tasks. When an individual thinks about his or her learning concerning a new learning task, he or she will first either resort to his or her repertoire of existing strategies

he or she already knows or actions he or she took in the past. When the existing strategies/actions cannot successfully tackle the task, he or she will be forced to consider other new strategies or actions.

Corroborating with Flavell (1979)'s framework, Schraw (2001) considered metacognition as including two main components: knowledge of cognition (knowledge) and the regulation of cognition (action). The main function of these two components is to help learners control his or her cognition. The first component, knowledge of cognition, involves knowledge of oneself and possible implementation strategies. Knowledge of oneself refers to one's understanding of individual strength and weakness as a learner. For example, a person might have an accurate estimate of his or her prior knowledge of a specific subject, and therefore, be able to identify potential future learning goals. Possible implementation strategies refer to the repertoire of cognitive strategies a learner already possesses to tackle learning tasks, such as critical thinking skills. The second component, regulation of cognition implies actions from learners. It refers to a set of activities to help students control their learning, such as consulting the teacher or finding supporting materials online.

Congruent with Schraw's (2001) two components of metacognition, Paris (1990) proposed two similar, yet almost identical, aspects of metacongition: self-appraisal and self-management of cognition. He defined self-appraisal as "reflection about knowledge and motivational states for the purpose of resolving a problem" (p. 17), which adds the reflective element to Schraw's (2001) concept of "knowledge of cognition." Another aspect of metacognition, self-management as proposed by Paris (1990) is defined as "the metacognitive orchestration of actually solving a problem." This is almost the same as

the concept of regulation of cognition proposed by Schraw (2001). Both constructs imply the thinking processes and the actions taken to iteratively adjust one's cognitive strategies when engaging in learning tasks.

Although there is still no general consensus of the most agreed-upon definition of metacognition (Hacker, 1998), almost all previous efforts to define metacognition include notions of "knowledge of one's knowledge, processes, and cognitive and affective states, and the ability to consciously and deliberately monitor and regulate one's knowledge, processes, cognitive and affective states" (Hacker, 1998, p. 11).

Flavell (1987) emphasized that metacognition is congruent with the learners' need and desire to "communicate, explain and justifying thinking to organisms as well as to himself" (p. 27). Because learning is socially situated in an educational context, interaction and communities are especially important to foster cognition and metacognition (Schraw, 2001); they provide learners with the best environment to develop metacognitive knowledge and skills by constantly providing external feedbacks (Flavell, 1987; Lin, Hmelo, Kinzer, & Secules, 1999; Schraw, 2001).

Although closely related, metacognition and cognition are two distinct constructs. Flavell (1979) argued that metacognitive experiences and knowledge differ from an individual's cognition in content and function, but not in quality. According to his framework, the relation between cognitive and metacognitive strategies is that "cognitive strategies are invoked to make cognitive processes and metacognitive strategies to monitor these" (p. 909). The monitoring of cognitive experiences requires actions and interactions among metacognitive knowledge, metacognitive experiences, goals/tasks and action/strategies.

Relationships between Metacognition and Self-Regulation

The close relationship between self-regulation and metacognition can be reflected in their definitions. Zimmerman (1995) defined self-regulation as the degree that "individuals are metacognitively, motivationally, and behaviorally active participants in their own learning process" (p. 3). He further emphasized that self-regulation involves more than metacognitive knowledge and skill; it also involves the motivational and behavioral processes to put someone's beliefs into action (Zimmerman, 1995). Based on Zimmerman's framework, metacognition, which involves the thinking process, is considered the precursor as well as the predecessor of self-regulation, which initiates the physical and mental behavior that puts these thoughts into action. The definition of metacognition by Ford, Smith, Weissbein,Gully, and Salas (1998) further corroborates this reciprocal relationship as delineated by Zimmerman (1994, 1995). They defined metacognition as the process by which "an individual exerts self-regulatory control over his or her cognitions" (p. 220). Previous research (Fincham & Cain,1986; Paris & Oka, 1986) further confirmed that students with better control over their metacognition use more cognitive strategies and tend to persist longer on their learning tasks. In his study, Zimmerman (1990) further suggested that self regulated learners are more aware of their thinking processes, especially when they are using or not using certain knowledge or skills. In addition, they tend to actively seek information that they are missing and take necessary steps to acquire it. Overall, self-regulation and metacognition are highly related in the sense that they can initiate each other when it is required by the situation. However, metacognition only involves the thinking process, while self-regulation implies both thought and action.

Relationships between Metacognition and Critical Thinking

The close ties between metacognition and critical thinking have been discussed by several scholars in the research literature (Brookfield, 1989; Dewey, 1933; Garrison, 2002; Willingham, 2008). The importance of metacognition to critical thinking is expressed in the definition of the terms. When discussing higher order thinking and what it entails, Dewey (1933) posited that higher order thinking refers to the induction of reflection through questions and the active monitoring of an individual's inquiry for the purposes of improving his or her understanding. He emphasized that higher order thinking implies an inward contemplation that causes connections between ideas and facts. Brookfield (1989) also argued that critical thinking includes both a commitment to seek truth, as well as a commitment to maintain reflective skepticism by the individual.

Metacognition is so crucial to an individual's development of critical thinking because it provides an impetus to improve and facilitate one's critical thinking (Davison and Sternberg, 1998; Corliss, 2005; Dominowski, 1998). Davison and Sternberg (1998) posited that based on one's knowledge of his or her own thinking, she or he will be able to strategically perform the tasks of encoding problems, forming mental models, identifying possible obstacles and selecting strategies to reach learning goals. The control aspect of metacognition helps learners make adjustments in plans and strategies accordingly during the critical thinking process (Corliss, 2005).

Studies of Effects of Metacognition on Critical Thinking or Higher Order Thinking Skills

Several studies in previous literature have reported the crucial role that metacognition plays in an individual's development of critical thinking or higher order thinking skills (Bielaczyc & Collins, 1999; Brown & Campione, 1994; Brown, Ash, Ruthford, Gordon, Campione, & Nakagawa, 1993; Hatano & Inagaki, 1992; Lin, 1999; Miller, 1978; Wineburg, 1997). In a study comparing novice and expert problem solvers, Dominowski (1998) found that, compared to experts, novice problem solvers rarely monitor their own problem solving process although it makes the problem solving more effective. He argued that metacognitive probing promotes a more reflective problem solving approach. In another study that examined the effects of metacognition on expertise, Hatano and Inagaki found that learners who constantly modified their actions based on their reflection journals showed more frequent construction and enrichment of their conceptual knowledge than those who failed to reflect on their actions. They concluded that systematic reflection journals of reflective learners on the effects of their actions and the consequences prompted them to constantly improve their thinking skills. In a second study that examined the effects of metacognition and aptitude on problem solving skills among fourth and fifth graders, Swanson (1990) found that students with high levels of metacognition needed fewer steps to find solutions for problems than lower metacognitive individuals. She found that high aptitude is only important in performance when metacognitive ability is low. In a sense, metacognitive skills can compensate for insufficiency in aptitude when students solve open-ended problems. Her study showed that high metacognitive ability positively influenced problem-solving performances.

Among different groups with various combinations of levels of aptitude and metacognition, the group with both high aptitude and high metacognition was found to have a richer array of heuristics and strategy subroutines than other groups. The result of Swanson's (1990) study showed that metacognition can reinforce general aptitude and can substitute for a lack of aptitude by supporting children with another domain specific to problem-solving.

Instructional Strategies to Promote Metacognition through Social Interaction

Studies of online learning environments in K-12 (Fabos & Young, 1999; Sherry, Travalin, & Billing, 2000) and in teacher education (Thomas, Clift, & Sugimoto, 1996; Schlagal et al., 1996; Wade et al., 2000) have shown that structures of instructional activities are crucial to supporting high levels of reflection among students. Based on his study to promote reflection among students in teacher education programs, Whipp (2003) found that a powerful scaffold of reflection should include four elements. First, the instructor should deliver the explicit expectations of reflection among students; reflection should be made the obvious learning task in the online environment. Secondly, instructors should provide sufficient support in helping students broaden and deepen their discussions. The facilitator should provide timely guidance and prompts when students are not making progress in the reflective discussions. Thirdly, well-defined roles require higher level cognitive activities, which engage and encourage higher levels of reflection among students. For example, in his study, Whipp (2003) assigned students to the roles of discussion leader, devil's advocate, and summarizer. He reported that these discussion roles effectively helped students with their reflective discussion by enriching the

discussion directions and topics. Fourthly, technical tools in the learning environment should be transparent to students. Since metacognitive tasks already impose extra cognitive loads on learners, a transparent technological environment will efficiently remove unnecessary cognitive demands from students. Blakely and Spence (1990) also described several basic instructional strategies that can be incorporated into classroom activities to help students develop metacognitive behaviors, such as asking students to constantly identify what they know as opposed to what they need to know, or encouraging students to keep reflective learning logs on their learning progress. Flavel (1979) further explained that the optimal condition to foster metacognition is through social cognition. The interaction within the learning environment is essential to facilitate the cognitive and metacognitive knowledge and strategies of a learner (Schraw, Crippen, & Hartley, 2006). Hartman (2001) posited that participating in discussions and having the opportunity to verbalize thinking strategies in a social environment encouraged development of metacognition. In order to support metacognition among learners in a social context, instructional strategies can follow one of the four general metacognitive goals (Lin et al., 1999). The table below lists each goal and corresponding design characteristics.

Table 1

Goals for Reflection and their Design Characteristics (Lin et al., 1999, p. 58)

Goals	Design Characteristics Incorporated
1. Show students what process they have gone through to accomplish a particular task	1. Process display features should be incorporated
2. Call students' attention to their own process while they are performing a particular task	2. Process prompt should be incorporated
3. Help students understand how an expert would analyze and solve a similar problem or to compare their own process with those of an expert	3. Process modeling features should be incorporated
4. Provide students with multiple perspectives on content or process through focused social discourse	4. Reflective social discourse features should be incorporated.

The optimal environmental to foster metacogintion requires both the appropriate instructional strategies and explicit metacognitive goals. The metacognitive goals guide the students' reflective efforts, while the instructional strategies scaffold the students' metacognition.

SELF-REGULATION

Definition of Self-Regulation

Although self-regulation is defined differently from study to study, all of the definitions of self-regulation refer to learners' experiences of monitor and controlling their learning through cognitive, metacognitive and motivational strategies (McManus, 1998). The first strategy set involves an individual's cognitive skills to process

information, such as analyzing information or making connections. The second strategy set, metacognitive strategies, involves skills that enable learners to understand and monitor their cognitive processes, such as the ability to constantly reflect on prior actions. The third strategy set, motivation strategies, involves beliefs and attitudes that affect the use and development of cognitive and metacognitive skills (Schraw, Crippen, & Hartley, 2006). Schraw, Crippen, and Hartley (2006) argued that each of these three components is necessary, but not sufficient, for self-regulation. Successful self-regulation requires all of the three components.

Adding to McManus's (1998) set of strategies, Pintrich (1999) identifies four required regulatory strategies: planning, monitoring, regulation and resource management. The first strategy, planning, refers to the process of students setting their own goals. He proposed two types of goals: process and product goals. He suggested that the goals should be generated by inner motivation, rather than imposed by external forces, such as parents or peers; otherwise, the students can easily lose their willingness to invest any efforts. In addition, process goals are more congruent with the iterative nature of self-regulation. They provide students with more opportunities to test their regulatory strategies and allow them more opportunities to modify their self-regulation during each stage of these process goals (Ertmer, Newby, & McDougall, 1996). A product goal, on the other hand, usually implies completion of an effort, and can discourage students from proceeding to the next phase of self-regulation. The second type of self–regulation strategy, monitoring, refers to students' mental efforts to be mindful of his or her attention. They help an individual constantly engage in the self-testing, self-questioning and self-monitoring of their comprehension. These planning and

monitoring strategies are precursors of students' controlling mechanisms. Without these two strategies, an individual will not know what regulatory actions he or she should take in order to improve his or her learning. The third type of regulatory strategy, regulation, involves a series of efforts to control one's cognitive strategies during a learning task. For example, a student constantly adjusts his or her approach to test hypotheses in order to more efficiently solve a problem. The last regulatory strategy, resource management, involves a person's effort to manage the available external and internal resources. By successfully coordinating these resources, a person provides himself or herself with more tools to efficiently finish the task. For example, a student who is trying to solve an open-ended civil question might resort to peers (external resources) and self-reflection (internal resources) to find a plausible solution. When combined with an individual's willingness to exercise these regulatory strategies, learners can more efficiently cope with the environmental and contextual factors of their learning (Pressley, Van Etten, Yokoi, Freebern, & Van Meter, 1998).

According to Garcia and Pintrich (1994), self-regulation is defined as students' initiatives to monitor, control and regulate their cognitive activities and behavior. It involves the interaction of four factors: knowledge, belief, strategy use and outcome. These interactions are moderated by emotional and cognitive components (Boekaerts, 1997; Garcia & Pintrich, 1994). The graph below shows McMahon and Oliver's (2002) model of self-regulation regarding the interactions of these factors.

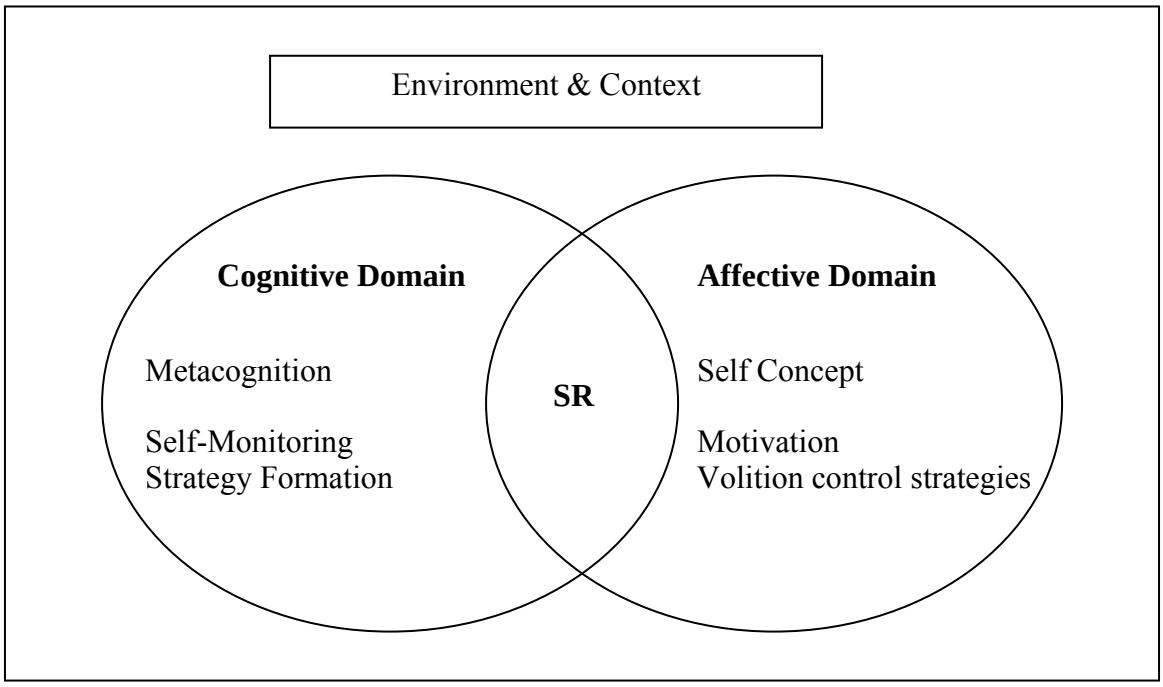


Figure 4. McMahon and Oliver's (2002) Model of Self-Regulation (p. 1301)

Self-regulation, like critical thinking, requires both the willingness and the skills to initiate regulatory thoughts or actions (Garcia & Pintrich, 1994). A self-regulated learner should be knowledgeable about his or her cognitive strategies and be willing to apply them in order to achieve his or her learning goals (Butler & Winne, 1995; Zimmerman, 2002). With the necessary cognitive skills and the desire to practice such skills, a learner will have the required tools to know how to modify his or her inquiry process when necessary.

In online learning contexts, self-regulation is especially important. Self-regulation is a proactive process that students can use to learn academic skills, such as setting their own learning goals or monitoring their critical thinking progress

(Zimmerman, 2008). McMahon and Oliver (2002) argued that self-regulation is especially important for learners in an online learning environment where there may be less direct instructional support than in traditional face-to-face models. They suggested that it is presumptuous to assume that students already have sufficient self-regulatory skills before they enter an online learning environment. They proposed that appropriate instructional strategies, such as scaffolding, are essential to help online learners become better at their self-regulation. They suggested that those instructional strategies are most efficient when they are integrated into the online learning environment, which supports self-reflection and peer feedback.

Relationship between Self-Regulation and Critical Thinking

The significance of self-regulation to individual critical thinking is demonstrated in several ways. First, self-regulation initiates an individual's effort to improve his or her critical thinking process. According to Dewey (1933), the learning cycle includes several iterated phases. Before any inquiry, a learner must perceive a need to solve a problem. He or she then searches for relevant information, constructs personal meaningful solutions and finally puts the ideas into action. Dewey (1933) proposed that the learners' awareness of these phases of inquiry helps them understand and select strategies and learning activities. Most importantly, self-regulation helps one to take actions to constantly modify the directions of his or her own critical thinking. Secondly, self-regulation provides learners with better management of their cognitive strategies and coordination of learning resources; when teachers make students aware of all the critical thinking skills, students will be more mindful about exercising their critical thinking skills. When students form the habit of monitoring and constantly adjusting their critical

thinking skills, self-regulation and critical thinking could form a self-enclosed support loop. The more self-regulated a student becomes, the better a critical thinker he or she will become and vice versa.

SUMMARY

Online Socratic seminars provide the optimal environment to trigger reflection and critical thinking (Jewell, 2005; Polite & Adams, 1996; Tredway, 95; Walters, 2003). Through metacognitive tasks supported by social interactions and technology, students can become better self-regulators and therefore, exert better control of their learning and critical thinking. Metacognitive awareness serves as the precondition for critical thinking and self-regulation (Garrison, 2002). Instructors can help develop this awareness through various instructional strategies, such as requiring students to reflect on their discussion in order to self monitor their application of critical thinking skills. Overall, online Socratic seminars can provide an environment to support metacognition, which in turn scaffolds self-regulation and enhances students' development of critical thinking.

Chapter III. RESEARCH METHODS

This study examined relationships between metacognition, self-regulation, and students' critical thinking skills and dispositions in online Socratic seminars for ninth grade World Geography and Culture classes. This study also investigated the teacher's and students' perception on the implementation and usefulness of the two metacognitive tasks and used the findings to triangulate results from the quantitative analyses. In this chapter, the design and procedure of this study is presented in the following order: (1) research questions (2) the research setting (3) participants (4) intervention (5) intervention grouping (6) course materials (7) instruments (8) data collection procedures and (9) data analysis procedure.

RESEARCH QUESTIONS

This study investigated four research questions and they are listed below.

Question 1. What are the effects of an intervention that involved metacognitive tasks on mean scores of students' critical thinking skills, critical thinking disposition or self-regulation in online Socratic seminars for high school social studies classes?

The first research question of this study addresses whether performing the two metacognitive tasks had any effect on the mean scores of students' critical thinking, critical thinking disposition or self-regulation between students in the comparison group and in the experimental group. Because only the experimental group completed the two metacognitive tasks, the researcher hypothesized that performing the two metacognitive

tasks would cause mean differences in students' posttest scores of self-regulation, critical thinking disposition, and critical thinking skills.

Question 2. Does an intervention that involved metacognitive tasks introduce any structural differences in the relationships among students' self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes? If so, in what way?

The second research question investigated whether the moderator, performing the two metacognitive tasks (metacognitive grouping), caused any structural variance in the relationships between students' critical thinking skills, critical thinking disposition and self-regulation. If the analysis shows significant moderating effect, it implies that the relationships between self-regulation, critical thinking skills and critical thinking disposition depends on whether or not students perform the two metacognitive tasks.

Question 3. What are the relationships among self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes?

This question includes the following four sub-questions.

a. Is there a significant relationship between self-regulation and critical thinking disposition?

b. Is there a significant relationship between self-regulation and critical thinking skills?

The third research question of this study aims to create a model of the relationships among self-regulation, critical thinking skills, and critical thinking disposition in both the experimental and comparison groups. The variables of interest are pretest self-regulation, posttest self-regulation, pretest critical thinking skills, posttest critical thinking skills, pretest critical thinking disposition, posttest critical thinking disposition.

Question 4. How do the teacher and students perceive the implementation and usefulness of an intervention that involved metacognitive tasks?

The fourth research question focuses on the teacher's and students' perception on the two metacognitive tasks: writing reflection journals and applying critical thinking tags in students' online posts. Since the implementation of these two metacognitive tasks is highly related to teachers and students' perceptions on their usefulness, understanding how teachers and students regard and implement them not only helps triangulate the quantitative analysis results, but also provides guidance on future design improvement. The table below lists all the variables of interest in this study as well as the instruments used to collect each.

Table 2

Variables and Instruments to Collect Each for the Quantitative Analysis

Concept	**Metacognition (Performing the two metacognitive tasks)**	**Self-Regulation**		**Critical thinking Disposition**		**Critical thinking Skill**	
Variable Name	Matacognitive grouping	Pretest Self-Regulation	Posttest Self-Regulation	Pretest Critical thinking disposition	Posttest Critical thinking disposition	Pretest Critical thinking skills	Posttest Critical thinking skills
Instrument		Self-Regulation Survey	Self-Regulation Survey	Critical Thinking Disposition Survey	Critical Thinking Disposition Survey	Critical Thinking Writing Report	Critical Thinking Writing Report
Values	0 = comparison group 1= experimental group	Composite score of values from 1-7 points	Composite score of values from 1-7 points	Composite score of values from 1-5 points	Composite score of values from 1-5 points	Composite score of values from 0-24 points	Composite score of values from 0-24 points

THE RESEARCH SETTING

The setting of this study was an online learning environment that accompanied traditional 9th grade world geography and culture face to face classes in a public high school. Starting from Fall 2007, the researcher introduced an online learning content management system to 9th grade pre-Advance Placement (pre-AP) world geography and culture classes in a public high school in South Central Texas. The original function of the online learning content management system was to support course related projects and share relevant resources among students. The online learning content management system was created using a Moodle content management system, which included features supporting social interaction and content management. The table below lists features and their applications used for this online learning content management system.

Table 3

Technical Features included in the Content Management System

Features	Applications
Discussion Board	Students used this open forum to post course project related questions and answered each others' questions. This forum includes the Q & A forum, discussion forum for the first and second online Socratic Seminars.
Wiki	Students used this collaborative writing tool to create a database of useful websites.
Chat	Students used this tool to communicate with others synchronously.
Resources	Teacher and students posted different resources in this area, including course-reviewing Podcasts, handouts or links to websites.
Assignments	Students submitted their assignments here.

Starting from Spring 2008, the world geography and culture teacher introduced Socratic seminars to her classes. According to Seeskin (1987), Socratic seminar is an instructional approach to help students examine their own and others' opinions in detail. It involves three general steps. The first step encourages participants to start with their honest opinions about an issue and share them with others. The second step prompts participants to examine what they still do not know about the issues based on self-

reflection and feedback from the group discussion. The third step encourages participants to continue the investigation. Depending on the scope of the curriculum, the three step cycle can have as many reiterations as possible. In this study, the teacher's instructional goal of adding Socratic seminars to her regular curriculum was to help her students become more critical thinkers. However, the new instructional approach also brought new challenges. She explained that the textbook was not stimulating enough to foster critical thinking among her students although the school district listed critical thinking as one of the desirable learning goals for 9th grade world geography and culture curriculum. The second challenge she encountered was to spare extra time for Socratic seminars out of her already tight schedule. The last challenge was that the in-class Socratic seminars were fast paced due to a limited time schedule; and it introduced more anxiety to introverted students. In order to help the teacher eliminate the above mentioned challenges, the researcher and the teacher agreed to expand the original online learning content management system to support online Socratic seminars. The teacher implemented the first trial of the online Socratic seminar among 150 students toward the end of Spring 2008. She concluded that the online Socratic seminar in the online learning content management system achieved the same instructional goal as the in-class Socratic seminars, but provided more flexibility and instructional support than the in-class Socratic seminars. Because of the successful pilot testing, the teacher decided to include the online Socratic seminars in her classes during Fall 2008. During that semester, the students had three Socratic seminars. The first Socratic seminar was in class so that the teacher could ensure that her students understand how they should proceed with the Socratic seminars. The second and the third Socratic seminars were online, but students

started the online Socratic seminars at the computer lab at the school library. Students completed the online Socratic seminars at home during the following week after their first online Socratic seminar at the school computer lab. Overall, the research setting of this study was an online learning content management system in a traditional public high school setting. It supported social and collaborative purposes including: online Socratic seminars, resource sharing, chat and general questions and answers about course-related issues.

During Fall 2008, the two topics for the three Socratic seminar about civics were: illegal immigrants (in class and online) and civil rights (online only). The table below lists timelines for each topics and instructional activities.

Table 4

Timelines for Each Topics and Instructional Activities

Fall 2008 Schedule		
	Topic	**Instructional Activities**
October 1 – November 1	How should our country deal/help with illegal immigrants?	1. Read and search for relevant articles 2. In-class Socratic Seminar (1st) 3. Online Socratic Seminar (2nd) 4. Related video project
November 16 - December 12	How can our country protect civil rights in the face of terrorist attacks?	1. Read and search for relevant articles 2. Online Socratic Seminar (3rd) 3. Related poster project

PARTICIPANTS

Participants of this study were 195 9th grade students in World Geography and Culture classes in a 4-year comprehensive high school in South Central Texas. They were from six pre-AP (Advanced Placement) world geography and culture classes. All of them had Internet access at home or at school. The sample demographic was homogeneous, including 90 % Caucasian students and 10 % minority students. In order to examine the design and effects of the two metacognitive tasks on students' development of critical thinking and self-regulation, the researcher randomly selected 3 out of the six classes to form the treatment group, which had to complete the two metacognitive tasks. The remaining 3 classes then formed the comparison group and were not asked to do either of them. Nevertheless, students in both groups were required to participate in the online Socratic seminars. There were 92 students in the experimental group and 103 students in the comparison group. The table below summarizes the grouping and the intervention assignment.

Table 5

Intervention and Grouping Design

	Experimental Group (3 classes)	**Comparison Group (2 classes)**
Critical Thinking Tag	Yes	No
Reflection Journals	Yes	No

RECRUITMENT PROCEDURE

Before the study, the researcher obtained the Human Subject Institutional Review Board approval from both the school district and the university (See Appendix A & B). The researcher first provided the teacher with a copy of the teacher consent form (See Appendix C). The teacher signed the consent form and returned it to the researcher. The teacher then distributed the student and parent form to her class at the beginning of the semester (See Appendix D). The consent forms requested permission from both the students and the parents to collect data on students' online discussions, performances on the instruments and interviews. The teacher and the researcher together explained the study and instruments to the students in class and to the parents in the parent-teacher meeting during the first week of the semester. About 95 % of the students submitted their and their parents' signed consent forms, which allowed them to participate in this

study. The other 5 % of the students did not submit their consent forms, which indicated their refusal to participate in this study. The table below lists the number of participating and nonparticipating students in each class.

Table 6

Number of participating and Non-participating students in each class

Group	**Class**	**Participating Students**	**Non-participating students**
Experimental	1	28	2
	2	33	1
	3	31	3
Comparison	1	33	1
	2	32	1
	3	38	2

INTERVENTION

The intervention in this study was two types of metacognitive tasks: applying critical thinking tags in the discussion forum and writing self-reflection journals after each online discussion. Previous literature and studies have shown that metacognition is an essential second-order cognition to foster critical thinking (Facione, 1990; Ingles, 2007; Kuhn, 1999; Lipman, 1991; Moshman, 1998; Norris & Ennis, 1989; Olsen & Astington, 1993; Paul, 1990; Siegel, 1988). In this study, these two specific instructional strategies were implemented to scaffold metacognition among students in the experimental group.

Critical Thinking Tags

Garrison (2002) argued that in a social context, learners must have opportunities to monitor and reflect on their knowledge construction process in order to support higher order learning, such as critical thinking. Researchers have found that instructional strategies must foster better social and cognitive presence, which provide the supportive environment to promote metacognition (Cho & Jonassen, 2002; Renninger & Schumar, 2004; Scardamalia, 1996). If discussions and think-aloud thinking strategies are combined, students will have more opportunities to develop metacognition (Hartman, 2001). To help students reflect on their knowledge construction in an online discussion, researchers have found cognitive constraints or thinking tags to be one effective instructional strategy (Cho & Jonassen, 2002; Scardamalia & Bereiter, 1996; Schellens, et al., 2009) The critical thinking tags are a set of discussion constraints, which guide students' metacognition in their thinking process. The thinking tags usually correspond

to desired actions or contents from the participants. Before the students may assign thinking tags to their posts, they must perform two levels of thinking processes. First, they have to think about their thinking process as manifested in their post. Second, based on this reflective process, they have to evaluate their post against the list of thinking skills embedded in the thinking tags.

In this study, critical thinking was the target learning goals for students' online Socratic Seminar discussions. The thinking tags were based on the critical thinking skills that students might use in their online discussions. They served mainly two functions. The first function of the critical thinking tags is to stimulate students' metacognitive monitoring of their own thinking process, especially their critically thinking process. In a problem-solving process, there are generally two spaces of internal interactions (Scardamalia, Breiter, Burtis, Calhorn, & Smith, 1992). The first space, the content space, represents "What do I know?" while, the second space, the rhetoric space, represents "What do I say?" The interaction of these two spaces constantly pushes students to evaluate their current level of understanding against their goals. With the help of the critical thinking tags, which represent the desired cognitive skills students can not only make their thinking process visible, but also can improve their performances in the interaction of these two spaces. If the instructor or the system requires students to self-evaluate and reflect on their posts before they make them public, students must think about their existing knowledge of the discussion topic against the list of tags before they can assign one appropriate critical thinking tag to their post or write a posts that demonstrated their critical thinking skills. Because each post reflects the students' current learning process, if none of the tags from the exhaustive list apply to the students'

posts, students will not be able to assign any critical thinking tags to their posts and, therefore, will be forced to reflect on their thinking process again and modify their posts until their posts demonstrate the critical thinking skills embedded in the critical thinking tags. Nevertheless, students could also choose to target a critical thinking tag first and then write a post around the targeted critical thinking skill(s). This proactive approach would not only expand their discussion topic, but also guide them to use specific critical thinking skills in their online posts. The second function of the critical thinking tags is to scaffold and sustain critical discourse in online discussions. As Anderson and Garrison (1995) proposed, "critical discourse leads to deeper meaning and development of higher order cognitive skills in all subject areas" (p. 185), by encouraging students to reflect on the critical thinking skills they use in an online discussion, their discussion will become more meaningful and, therefore, provide them with a richer context to reinforce their critical thinking skills.

An example application of the thinking tags is in the Computer Supported Intentional Learning Environments (CSILE). In CSILE, the system requires students to assign thinking tags before they can submit their posts to the discussion form. Thinking tags in the CSILE environment could include:

P=Problem
MT= My Theory
INTU= Need to Understand
NI= New Information

The purpose of these tags is to help students reflect on their thinking process before they contribute to the discussions. By making their thinking process and themselves objects of reflection, students can more effectively advance their thinking to

higher levels. In their study on argumentative discussions, Cho and Jonassen (2002) asked students to pre-classify their contributions based on a set of tags that include (a) hypothesis (b) data (c) principles (d) unspecified and (e) three links: "for", "against", and "And". Their study found that the tags scaffold argumentation skills by making an individual's thinking process visible, and effectively producing better problem-solving activities. Although thinking tags in Scardamalis and Berieter (1996) and Cho and Jonassen's (2002) studies emphasized different learning tasks, both of them effectively prompted students to reflect on their thinking process and, therefore, direct them to expand their existing knowledge, skills and attitude on the learning subject.

At the beginning of this study, each student in the study received a critical thinking training package (see Appendix F). In the package, there is a list of critical thinking skills for students' reference. Although all participants in this study received the critical thinking skills training and had a copy of the critical thinking training package, only students in the experimental group were required to add the critical thinking tags every time they posted in the online Socratic Seminars. In the experiemntal group, students referred to the upper level critical thinking skills in the list for the critical thinking tags to apply to their posts. They could both reflect on their posts first, and then decide which critical thinking skills they used in each posts; or they could target specific critical thinking skills first, and then write posts around them. They then manually typed critical thinking tags on the bottom of each post before they submitted them to the forum. A screenshot below shows an example post with the critical thinking tags.

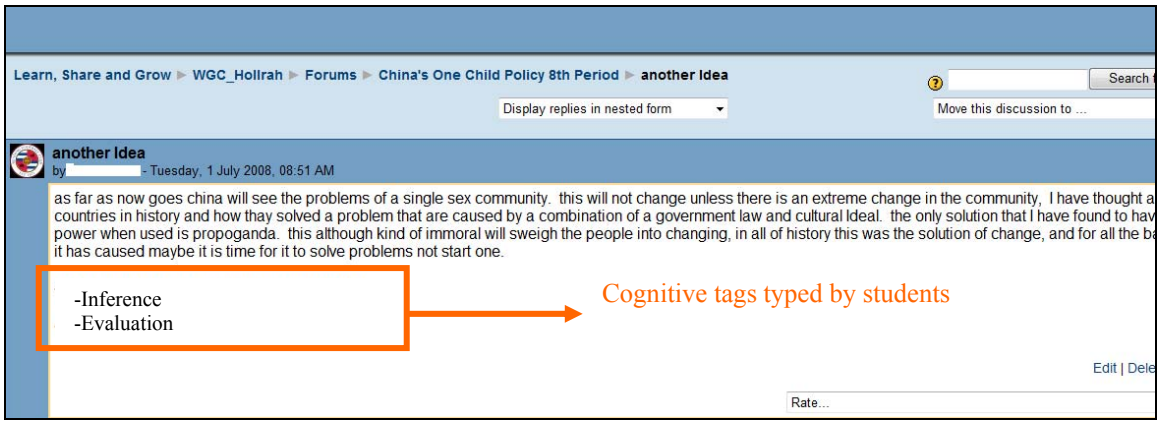


Figure 5. Screenshots of an Example Post in the Discussion Forum

Reflection Journals

Pellegrino (2004) proposed that teachers should explicitly emphasize metacognition to students when students are unaware of its importance. He argued that reflection is one aspect of metacognition that is critical to develop students' abilities to regulate their learning. The reason why reflection is so important to an individual's ability to regulate his or her learning is that reflection creates mental models of their learning strategies. With the assistance of the mental model, learners can constantly adjust their learning based on feedback from the external environment and inner feedback that they generate. The study by Simpson and Courtney (2007) also confirmed the significant effect of writing reflection journals on students' critical thinking.

In this study, the second instructional strategy to scaffold metacognition among students required students to reflect upon each of the two Socratic Seminar topics. Students wrote a reflective journal after they finished all instructional activities for that

topic. In order to encourage more honest reflection journals, all the reflection journals were anonymous and only accessible to the teacher and the researcher (See appendix N for the complete list of prompting questions for the reflection journals)

Because the purpose of such reflection is to improve students' ability to provide themselves with internal feedbacks about their learning process (Berandi-Coletta, Dominowski, Buyer, & Rellinger, 1995), through internal feedbacks, students collect comparative information about their previous experiences, their current progress and their future learning goals. Students can then modify or strengthen their tactics and strategies accordingly when tackling the same learning task in the future. Results of their follow up monitoring and actions then initiate another cycle of their internal feedbacks. The new learning cycles created by this iterative process will gradually become a constant cycle of self-regulated activities (Corliss, 2005). Overall, reflection journals serve as catalysts to start the cycle of self-regulated activities, which in turn produce more effective and more successful critical thinking.

TRAINING TO PREPARE STUDENTS FOR THE ONLINE LEARNING ENVIRONMENT AND ONLINE SOCRATIC SEMINARS

Although students in the comparison group were not required to complete the two metacognitive tasks, they received the same preparation and training as students in the experimental group. There were two orientation trainings for all the participants. The first training presented critical thinking and its sub skills to students. The teacher explained what critical thinking is and importance of developing it. She used examples and discussions to help students understand critical thinking skills and how to apply them

in their daily lives, especially in an online learning environment. She also discussed with her students the sub-skills implied in critical thinking and showed them examples of the sub skills (see Appendix E for the complete training handout). The second training oriented students with security, netiquette and technologies involved in the online community. The teacher used PowerPoint slides and tutorial videos to explain and demonstrate security tips, netiquette (Internet etiquette) and features in the content management system.

RESEARCH DESIGN

This study was a mixed design and utilized both quantitative and qualitative data to investigate four aspects of the study: (a) direct effects of performing the two metacognitive tasks on students' self-regulation and critical thinking (b) moderating effects of performing the two metacognitive tasks on the relationship between students' self-regulation and critical thinking, and (c) the relationship between students' self-regulation and critical thinking, and (d) the teacher and students' perception of the implementation and usefulness of performing the two metacognitive tasks. Quantitative data was used as the primary data source while the qualitative data was employed to triangulate results from the quantitative analysis.

INSTRUMENTS AND DATA COLLECTION PROCEDURES

Several types of instruments were employed to answer the research questions for this study.

Self-Regulation Survey

Based on their study of the effects of motivation and self-regulation on 7th graders' academic performance, Pintrich and DeGroot (1990) modified the original question sets for self-regulation from the Motivated Strategies for Learning Questionnaire (MSLQ) and designed a new self-regulation survey composed of a set of 27 questions. This survey was chosen because the age level of participants in Pintrich and DeGroot's (1990) study was closer to participants' age levels in this study. The pilot testing conduced by the researcher during Fall 2008 yielded high internally consistent reliability (Cronbach's alpha = .821). This survey was implemented at the beginning and at the end of the semester to compare students' existing and exiting levels of self-regulation before and after they participated in the online Socratic seminars. Students rated their agreement with each statement in a series of questions using a Likert scale of 1-7. Students took about 15-20 minutes to complete the survey in the classroom before and after the study (see Appendix G for the complete survey).

The survey result was entered into Microsoft Excel and scores on each survey question were averaged to form a composite score for the pretest of self-regulation and posttest of self-regulation.

Critical Thinking Disposition Survey

In his study examining the effects of media literacy on students' development of critical thinking dispositions, Thayer (2006) adopted the critical thinking disposition survey based on studies by Facione (1992) and Rudd (2000). The instrument was chosen for this study because it was designed for students of the same age as the participants of

this study. The pilot testing conducted by the researcher during Fall 2008 yielded high internally consistent reliability (Cronbach's alpha = .90). In the study, students completed this survey once at the beginning and once at the end of the study. They rated how much they agreed with each statement on a scale of 1-7. Students took about 15-20 minutes to complete the survey in the classroom. The pre and post survey results provided the researcher with information on students' existing and exiting levels of critical thinking disposition during the course of the study (see Appendix H for the complete survey).

The survey result was entered into Microsoft Excel and scores on each survey question were averaged to form a composite score for the pretest critical thinking disposition and posttest critical thinking disposition variable.

Writing Assignment to Assess Critical Thinking Skills

In order to collect information on students' critical thinking skills manifested in students' writing, students wrote two critical thinking reports in class, one at the beginning and the other one at the end of the study. In the reports, students answered one of the two questions they discussed in their Socratic Seminars, such as, how can our country protect civil rights in the face of terrorist attacks? They wrote their answer on the same sheet as the questions and completed them in 50 minutes during class.

In the existing literature, standardized tests and critical thinking writing reports are the most common approaches to assess students' critical thinking skills. A previous study by Thayer (2006) confirmed the validity of this instrument to test critical thinking skills for a similar demographic group, this study used writing reports to evaluate the development of students' critical thinking skills. In Thayer's (2006) study, participants

answered a set of questions that evaluated their thinking processes when they analyzed contents of a video. He then graded their answers to assess whether or not they used any of the critical thinking skills (e.g. evaluation) based on the critical thinking rubric he developed. The rubric delineates each sub skill corresponding to the six core critical thinking skills. Each report was graded based on how many categories of critical thinking skills a student applied to his or her report (see Appendix K for the complete rubric and Appendix O & P for the pre and post writing assignment guideline). Each category of critical thinking skills was counted only once even if the participant used that critical thinking skill multiple times in his or her answers.

Based on Thayer's (2006) rubric and grading procedure, the researcher and another grader first randomly graded 20 (10%) students' writing and then discussed any discrepancies in their grading. In the second round, the researcher found differences between her and the other grader's grading, she and the rater then discussed the discrepancy for the second time until they reached an agreement. They then again graded the original 20 report individually. In the third round, the researcher and the rater reached 100 % agreement. The researcher then finished grading the rest of the writing assignment.

Scores for the writing assignments were entered into Microsoft Excel and were summed across the six sub skills to form a composite score for the pretest critical thinking skill and posttest critical thinking skill variables.

Opinion Survey

After students in the experimental and the comparison group completed all of the instructional activities for the two Socratic Seminar topics, they completed an opinion survey (see Appendix I & J), which asked for their perceptions and suggestions on the online Socratic Seminars. Students in the experimental group answered two extra questions that asked for their perceptions and suggestions on the critical thinking tags and reflection journals. Data from the opinion survey were entered into Microsoft Excel. Emerging themes were extracted using the emergent coding approach (Haney, et al., 1998), and percentages for each theme were calculated using descriptive statistic analysis.

Interviews

The researcher interviewed both the teacher and students toward the end of the study. For the teacher's interview, the researcher conducted a formal interview with the teacher toward the end of the semester (see Appendix R for the teacher interview protocol). The interview was audio taped. The purpose of the interview was to understand how the teacher perceived and implemented the instructional activities in the online Socratic seminars. The researcher contacted the teacher and set up a convenient meeting time and place, then held the interviews that lasted about 30-45 minutes.

For the students' interview, the researcher randomly selected 13 students from the experimental group whose parents approved their participation. The interviews were also audio taped (see Appendix Q for the student interview protocols). The purpose of the interview was to understand how the students perceive and implement the two metacognitive tasks in the online Socratic seminars. The student interviews were

arranged by the teacher and held in the classroom during the lunch hours when the teacher was also present. Each student interview lasted approximately 15 to 20 minutes.

Both the teacher and student interviews were imported and transcribed using the Express Scribe software. The researcher then extracted emerging themes from the teacher and students' interviews using the emergent coding approach (Haney, et al., 1998).

Researcher's Observations

The researcher observed the teacher's six classes once each week and took observation notes. During the observation, the researcher sat in the back of the classroom and entered her notes into Microsoft Word documents in her laptop computer. Each observation was labeled with the observation date and the class period. In the observation, the researcher recorded the classroom activity, materials used for that period, and students' and the teacher's behaviors. The researcher also recorded the classroom environment, including announcements on the blackboard and school wide events. The table below shows the study design and data collection instruments.

Table 7

Study Design and Data Collection

	Pretests	Intervention	Posttests	Observations
Experimental Group	1. Self-regulation survey 2. Critical thinking disposition survey 3. Critical thinking skill writing	Metacognitive Tasks (a)Critical thinking tags (b) Reflection journals	1. Self-regulation survey 2. Critical thinking disposition survey 3. Critical thinking skill writing	Observation once each week
Comparison group	1. Self-regulation survey 2. Critical thinking disposition survey 3. Critical thinking skill writing	X	1. Self-regulation survey 2. Critical thinking disposition survey 3. Critical thinking skill writing	Observation once each week

DATA PREPARATION

Several steps were involved in the data preparation process. First, both quantitative and qualitative data were entered into Microsoft Excel or Microsoft Word software. After checking for data entry accuracy, the complete set was then imported into SPSS. Next, reverse coding items were converted back to the corresponding scale in SPSS. Then, missing data were imputed using the maximum likelihood procedure. Although there are other popular approaches to process missing data, the maximum likelihood procedure is considered the most advantageous and accurate approximation (Arbuckle, 2007; Byrne, 2001; Schumacker & Lomax, 1996). Finally, scores from each instrument were combined and averaged to form composite scores representing each of the six variables: pretest self-regulation, pretest critical thinking disposition, pretest critical thinking skills, posttest self-regulation, posttest critical thinking disposition and posttest critical thinking skills.

DATA ANALYSIS

The data analysis approach for each research question is explained based on each question below.

Question 1. What are the effects of an intervention that involved metacognitive tasks on mean scores of students' critical thinking skills, critical thinking disposition or self-regulation in online Socratic seminars for high school social studies classes?

The hypothesis for the first question is below.

H1: An intervention that involved metacognitive tasks would cause mean differences in students' self-regulation, critical thinking disposition and critical thinking skills. A substantial number of participants in the experimental group would score higher on the posttests of self-regulation, critical thinking disposition and critical thinking skills.

A multivariate analysis of covariance (MANCOVA) was implemented to answer this research question. In order to control for the effect of the three pretests on the three posttests, the three pretests: pretest self-regulation, pretest critical thinking disposition and pretest critical thinking skill were introduced as the covariates. Performing the two metacognitive tasks (metacognitive grouping) is the factor variable, while the dependent variables were the three posttests: posttest self-regulation, posttest critical thinking disposition and posttest critical thinking skill. Before the F-test, the Box's test of equality of covariance matrix and Levene's test of error variances were implemented to ensure that the equal error variance and covariance matrix assumptions were met.
The second research question focused on the moderating effect of performing the two metacognitive tasks (metacognitive grouping) on the relationships between students' self-regulation, critical thinking skills and critical thinking disposition. The third research question investigated the relationships between students' self-regulation and critical thinking skills, and the relationships between self-regulation and critical thinking disposition in both the experimental and comparison groups. The two research questions and their hypotheses are listed below.

Question 2. Does an intervention that involved metacognitive tasks introduce any structural difference in the relationships among students' self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes? If so, in what way?

The hypothesis for the second question is below.

H1: An intervention that involved metacognitive tasks would significantly moderate the relationship between students' self-regulation and critical thinking. It would introduce structural variance to the relationship between the experimental and comparison group.

Question 3. What are the relationships among students' self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes?

The hypothesis for the third question is below.

H1: Self-regulation has statistical significant effects on critical thinking disposition. Students who score higher on self-regulation also score higher on critical thinking disposition.

H2: Self-regulation has statistical significant effects on critical thinking skills. Students who score higher on self-regulation also score higher on critical thinking skills.

To answer the 2nd and 3rd research questions, the researcher created a model delineating the relationships among the constructs in a structural equation modeling analysis. Performing the two metacognitive tasks (metacoognitive grouping) was introduced as the moderating variable in this model. In the analysis, the focus was on the structural equation model, which investigated the relationship among variables and examined the effects of the moderating variable on the relationships between self-regulation, critical thinking skills and critical thinking disposition. Based on Keith (2006) and Kline's (2004) suggestion, this analysis followed the five steps of model testing: model specification, identification, estimation, evaluation, and modification. First, a tentative model was drawn based on previous theory and research. Second, the researcher checked the identification status of the model to ensure there was enough existing information for the estimation. Third, the model was entered into the Amos software and was estimated for the free parameters. Fourth, the result was evaluated against a set of fit indices to test if the implied model adequately explained the observed data. Because χ^2 is influenced by sample size (Kieth, 2006), and this study (N= 195) approximated the minimum requirement of 200 samples for a medium sample size for a structural equation modeling analysis (Kline, 2004), the root mean square error of approximation (RMSEA), which is less influenced by sample size (Keith, 2006), was chosen as the main measure of fit for this analysis. Supplementary measure of analysis fit included the Akaike Information Criterion (AIC) and comparative fit index (CFI). According to Browne and Cudeck's (1993) criteria, RMSEAs below .05 suggest an acceptable fit of the model, while CFIs over .90 represents an adequate fit of model to

data (Hu & Bentler, 1999). Finally, the model was modified based on the modification indices until an acceptable model fit was reached.

To complete the above analysis, the raw data was first imported into the structural equation modeling analysis software, AMOS. Then, the multiple group comparison was completed in the ensuing six steps of model testing. The multiple group analysis tested the affect of the moderator, performing the two metacognitive tasks (metacognitive grouping), to determine if it introduced any structural variance in the relationships between self-regulation, critical thinking skills and critical thinking disposition. Based on Keith's (2006) suggestions for multiple group comparison, data from the experimental group was first utilized to create the base line model. The good fitting base line model was then tested using the data from the comparison group. Once the model achieved reasonable fit across the two groups individually, the final model was estimated across the two groups in a single test in Amos. The final model was then compared against the invariant model to examine the moderating effect of performing the two metacognitive tasks. The final accepted model also showed the path coefficients between each pair of the variables.

Question 4. How do the teacher and students perceive the implementation and usefulness of an intervention that involved metacognitive tasks?

To answer the 4th research question, the researcher used data from the students' and the teacher's interviews, the researcher's observation, along with the opinion survey. A content analysis was implemented to extract emerging themes and calculate percentages of each emerging theme. This analysis followed the emergent coding

approach suggested by Haney, Russell, Gulek, and Fierros (1998). The basic analysis involved 4 basic steps. First, the researcher and another coder independently reviewed the data and formed a checklist of the potential features. Second, the researcher and the coder compared their checklist and reconciled any discrepancies. Third, the researcher and the coder independently coded the material again using the reconciled list of codes. Fourth, the reliability of the coding was calculated: if at least 95% of agreement was reached, the coding was then applied to the data again to finalize the analysis. However, if acceptable reliability was not reached, the researcher and the coder then repeated the steps until adequate reliability was achieved.

SUMMARY

This chapter described the research design and methodology of this study. Several pieces of information were provided including: demographics of the participants, research setting, recruitment procedure, intervention design, data collection procedure and data analysis approaches. The quantitative analysis addressed the first three research questions that examined the relationship among variables and effects of performing the two metacognitive tasks. The qualitative analysis answered questions in regard to the teacher's and students' perception of the implementation and usefulness of the two metacognitive tasks.

Chapter IV. RESULTS

This chapter discusses results of the data analysis in the following three sections. The first section addresses the first research question. The result shows that students in the experimental group scored higher of self-regulation compared with those in the comparison group. However, mean scores in critical thinking skills and critical thinking disposition were not statistically different between the two groups. The second section addressed the second and third research question. The result for both groups showed that performing the two metacognitive tasks did not influence the relationships between self-regulation, critical thinking skills and critical thinking disposition. It also revealed that self-regulation is positively related to critical thinking disposition. However, the relationship between self-regulation and critical thinking skills, and the relationship between critical thinking disposition and critical thinking skills were not significant in both the experimental and comparison groups. Finally, the content analysis results answered the fourth question in regard to the teacher's and students' perception of the implementation and usefulness of the two metacognitive tasks.

MEAN COMPARISON

The first research question examined if performing the two metacognitive tasks has any effect on the three posttest scores (posttest self-regulation, posttest critical thinking disposition and posttest critical thinking skills). The hypothesis was that performing the two metacognitive tasks would cause mean differences in students' posttest scores of self-regulation, critical thinking disposition, and critical thinking skills.

The researcher hypothesized that a substantial number of participants in the experimental group would score higher on the posttests of self-regulation, critical thinking disposition and critical thinking skills. In order to control for any effects of the three pretests, a multivariate analysis of covariance (MANCOVA) was employed to assess the hypothesis for the first research question.

Before the MANCOVA analysis, the Box's test of equality of covariance matrix and Levene's test of error variances tested if the normality assumption was met. Both tests showed equal error variance and covariance matrix assumptions were met. The result of Box's test of equality of covariance matrix tests (p >.05) indicated that the observed covariance matrices of the three posttests were equal across groups (see Table 8). Levene's test of equality of error variances tests yielded insignificant value in posttest critical thinking skills (p >.05), posttest self-regulation (p >.05), and posttest critical thinking disposition (p >.05), indicating that the error variances of the posttest critical thinking skills, posttest self-regulation, and posttest critical thinking disposition variables were equal across the two groups (see Table 9). Table 10 shows the adjusted mean and standard deviation of each variable.

Table 8

Box's Test of Equality of Covariance Matrices

Box's M	F	df1	df2	Sig.
2.956	.484	6	260752	.821

Table 9

Levene's Test of Equality of Error Variances

Source	F	df1	df2	Sig.
Posttest critical thinking Skill	.331	1	193	.566
Posttest critical thinking Disposition	1.794	1	193	.182
Posttest self-regulation	.471	1	193	.493

Table 10

Adjusted Mean and Standard Deviation of Each Variable

				95% Confidence Interval	
Dependent Variable	Group	Mean	Std. Error	Lower Bound	Upper Bound
Posttest Critical Thinking Disposition	0	3.636[a]	.051	3.535	3.736
	1	3.674[b]	.058	3.558	3.790
Posttest Critical Thinking Skill	0	4.896[a]	.245	4.409	5.383
	1	4.507[b]	.232	4.047	4.968
Posttest Self-regulation	0	4.273[a]	.064	4.145	4.400
	1	4.718[b]	.066	4.586	4.850

a. Covariates appearing in the model are evaluated at the following values:
Pretest Critical Thinking Disposition = 3.7189, Pretest Critical Thinking Skill = 6.4367, Pretest Self-regulation = 4.1708.

b. Covariates appearing in the model are evaluated at the following values:
Pretest Critical Thinking Disposition = 3.6866, Pretest Critical Thinking Skill = 5.8169, Pretest Self-regulation = 4.4008.

The between-subjects multivatiate analysis of covariance was next performed to compare the experimental and the comparison group on the three dependent variables (posttest self-regulation, posttest critical thinking disposition and posttest critical thinking skills) after controlling for the effects of the three covariates (pretest self-regulation, pretest critical thinking disposition and pretest critical thinking skills). The multivariate analysis showed that differences for the three dependent variables were statistically significant between the experimental and comparison group [$F(3,188) = 5.493$, $p < .05$] (see Table 9). The univariate analyses (see Table 10) showed that performing the two metacognitive tasks caused statistically significant differences in mean scores of students' self-regulation [($F(1, 190) = 15.828$, $p < .05$). The mean score of 4.72 for the experimental group was statistically higher than the mean score of 4.27 for the comparison group. However, there were no statistically significant mean differences in mean scores of students' critical thinking disposition [$F(1, 190) = .140$, $p = .708$)] or critical thinking skills [($F(1, 190) = .976$, $p = .324$)] between the two groups. The results showed that performing the two metaocgnitive tasks did not cause any statistically significant difference in students' mean scores of critical thinking skills and critical thinking disposition between the experimental and the comparison group.

Table 11

Multivariate and Univariate Results Between Metacognitive Grouping: 3 Dependent Variables

Multivariate Results Between the experimental and the comparison group : 3 Dependent Variables

Source	Statistics	Value	F	Hypothesis df	Error df	Sig
Metacognitive Grouping	Hotelling's Trace	.081	5.493	3	188	.001

Univariate Results Between Metacognitive Grouping: 3 Dependent Variables

Source	Dependent Variable	F	Sig
Metacognitive Grouping	Post Critical Thinking Skills	.976	.324
Metacognitive Grouping	Post Critical Thinking Disposition	.140	.708
Metacognitive Grouping	Post Self-regulation	15.829	< .05

RELATIONSHIP AMONG VARIABLES

The second research question examined whether performing the two metacognitive tasks significantly moderated the relationships between students' self-regulation, critical thinking skills and critical thinking disposition. Because only the experimental group received the treatment, it was hypothesized that performing the two metacognitive tasks would significantly introduce structural variance to the above-mentioned relationships between the experimental and comparison group.

Structural equation modeling was implemented next to evaluate this hypothesized model, which delineated the relationships among self-regulation, critical thinking skills, critical thinking disposition and the moderating variable, performing the two metacognitive tasks (metacognitive grouping). This analysis involved testing the hypothesized model. If the hypothesized model showed an inadequate fit, the modified model based on previous research and the modification index was then tested. After the initial model produced an adequate fit to the sample data, a multiple group comparison based on metacognitive grouping (experimental vs. comparison) was next used to assess any structural variance in the relationships.

Before the structural equation modeling analysis, normality of each variable was examined. Table 12 presented the degree of normality of each variable. Based on the table, a certain degree of deviation from normality was revealed. None of the skewness values exceeded 1.0 and none of the variables produced kurtosis greater than the absolute value of three, which showed that the distributions of all the variables were not significantly abnormal.

Table 12

Assessment of Normality

Variable	*Min*	*Max*	*Skew*	*Kurtosis*
Pretest critical thinking Skills	.17	2.33	.33	-.48
Posttest critical thinking Skills	<.05	2.50	.81	1.34
Pretest critical thinking Disposition	2.24	4.83	-.09	0.7
Posttest critical thinking Disposition	1.26	5.15	-.38	.70
Pretest self-regulation	2.31	5.78	-.08	.10
Posttest self-regulation	2.26	6.24	-.19	-.11

The hypothesized model was then assessed using data from the experimental group to create a baseline model (see Figure 6). The analysis result produced a chi square value of 14.58 with 8 degrees of freedom (p >.05), indicating a good fit of the model to the sample data. The CFI of .90 indicated an adequate fit (Hu & Bentler, 1999). The root-mean square error of approximation (RMSEA) of .10 also suggested an acceptable model fit (Browne & Cudeck, 1993).

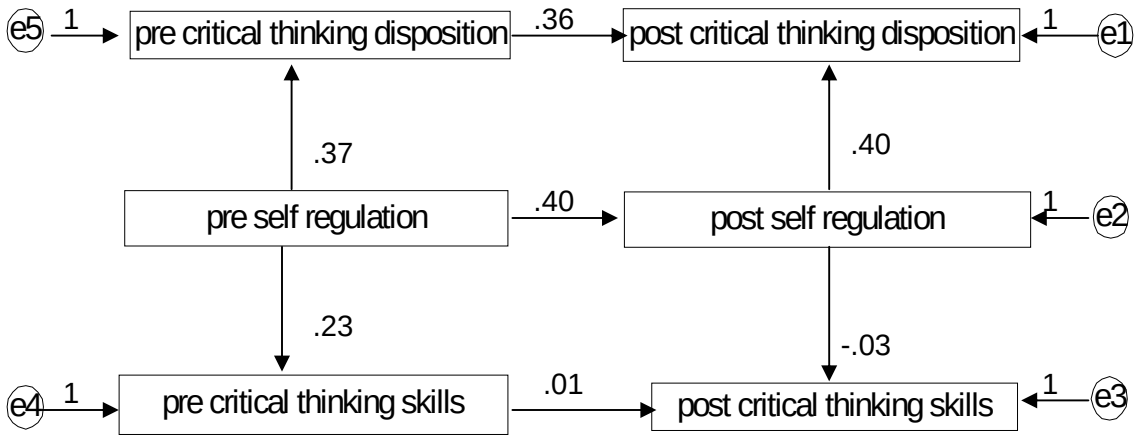


Figure 6. Initially-hypothesized model using the Data from the Experimental Group

Because the initial model yielded a globally fit of the model to the data from the experimental group, the same model was then tested using the data from the comparison group. Figure 7 presented the hypothesized model using data from the comparison group. The analysis result produced a chi square value of 12.18 with 8 degrees of freedom (p >.05), indicating an adequate fit of the model to the sample data. The CFI of .95 indicated a good fit (Hu & Bentler, 1999). The root-mean square error of approximation (RMSEA) of .07 also suggested a good model fit (Browne & Cudeck, 1993).

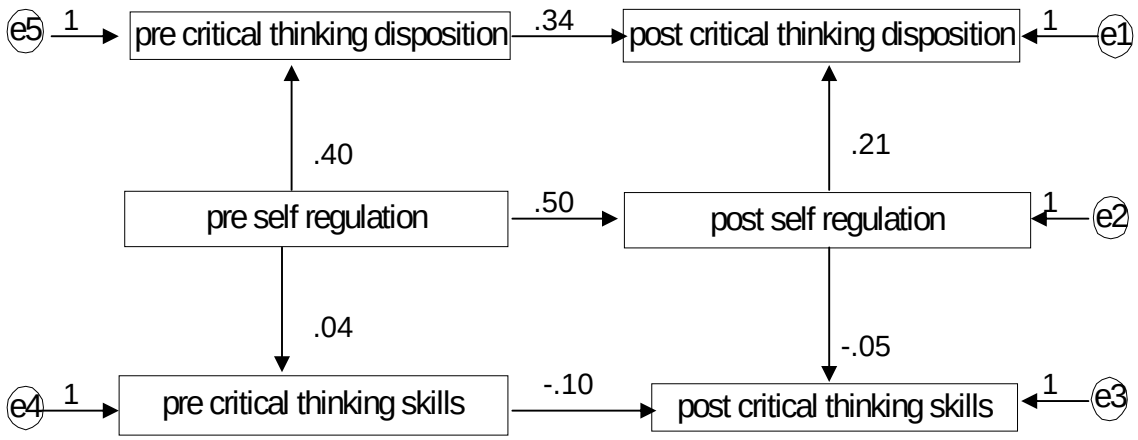
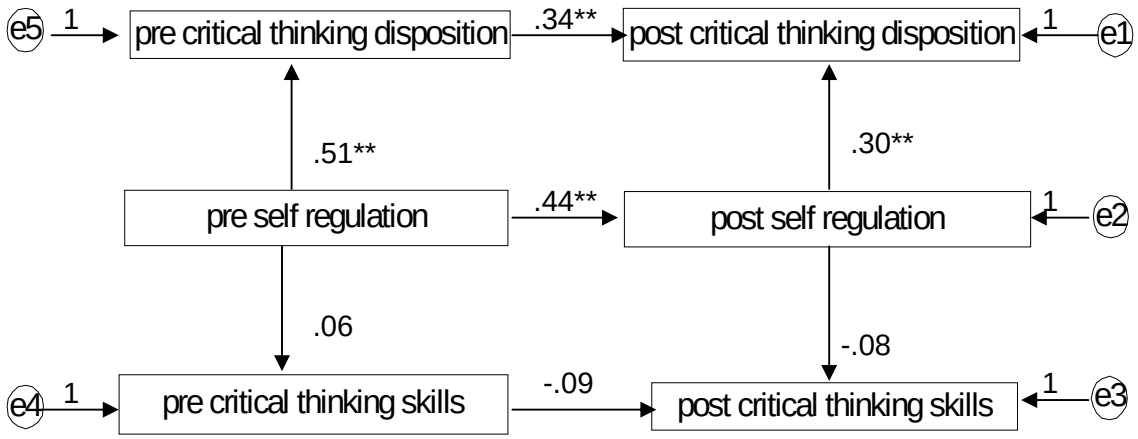


Figure 7. Initially hypothesized model tested using the Data from the Comparison Group

After the initial hypothesized model produced good fit for both of the groups, the same model was assessed again across the two groups in a single test. Figure 8 presented the hypothesized model using data from both groups in a single test. The analysis result produced a chi square value of 26.76 with 16 degrees of freedom (p = .04), indicating an inadequate fit of the model to the sample data. The CFI of .93 indicates a good fit (Hu & Bentler, 1999). The root-mean square error of approximation (RMSEA) of .06 also suggested a good model fit (Browne & Cudeck, 1993). Despite the mixture of results, this study gave more weight to estimates by CFI and RMSEA because the chi square test has been found to be influenced by the sample size (Keith, 2006), especially when this study barely met the medium sample size requirement suggested by Kline (2004). Therefore, the hypothesized model was considered an adequate fit of the data based on the RMSEA and CFI index.

Comparison Group



Experimental Group

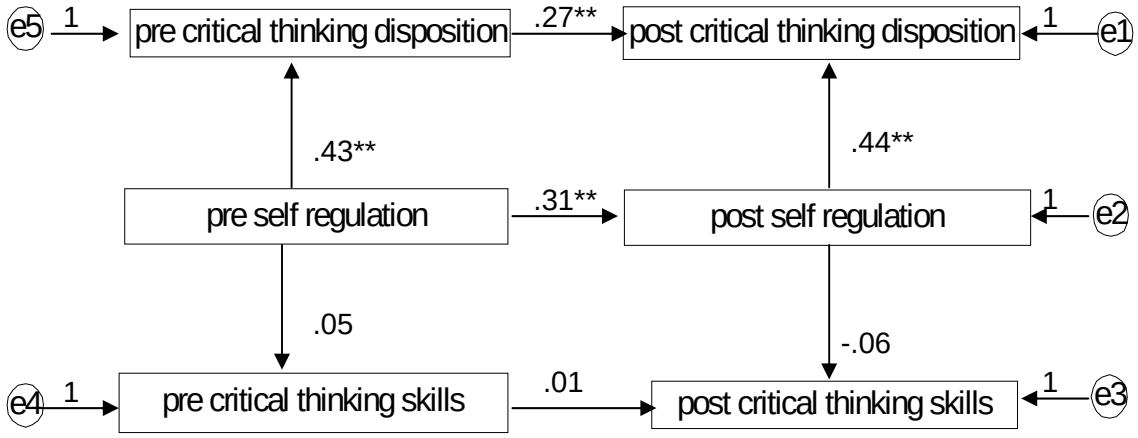


Figure 8. Initially hypothesized model tested using the Data from both Groups

Once the initial model indicated an adequate fit to the sample data, the multiple group analysis first created an invariant model, which set each parameter to be the same

between the groups. Table 13 presents the comparison of fit indexes for the initial model and the invariant model. The difference in the chi square value was 4.86 with 7 degrees of freedom (p = .68). Because the chi square difference was not significant, the more parsimonious model was favored. The result indicated that the invariant model was accepted and there was no statistically significant difference in the relationships between self-regulation, critical thinking skills and critical thinking disposition in the experimental and the comparison group. The hypothesis for the second research question was therefore rejected. The result showed that performing the two metacognitive tasks did not significantly moderate the relationship between self-regulation and critical thinking skills or the relationships between self-regulation and critical thinking disposition.

Table 13
Fit Indices for Model Comparison

Model	χ^2	df	$\Delta\chi^2$	Δdf	p	AIC	CFI	RMSEA(90%CI)
Initial	26.76	16				78.76	.93	.06(.01-.10)
Invariance	31.62	23	4.86	7	.68	58.70	67	.00 (.00-.04)

The third research question that examined the relationships between self-regulation, critical thinking skills and critical thinking disposition in both groups generated two hypotheses:

(1) Self-regulation has statistically significant effect on critical thinking disposition. Students who score higher on self-regulation also score higher on critical thinking disposition (2) Self-regulation has statistically significant effect on critical thinking skill. Students who score higher on self-regulation also score higher on critical thinking skills.

The path coefficients of the final model for the two groups were then examined to test the above four hypotheses for the third research question. Figured 8 presented the final model as well as the standardized path coefficients for both the experimental and the comparison group. The coefficient path showed that two out of the four hypotheses were accepted. The association between pretest self-regulation and pretest critical thinking disposition was significant for the comparison group (β=.51, $p < .05$) and for the experimental group (β=.43, $p < .05$), indicating that students who scored higher on the pretest self-regulation instrument also scored higher on the pretest of critical thinking disposition. In addition, the path coefficient between posttest self-regulation and posttest critical thinking disposition was also significant for the comparison group (β=.30, $p < .05$) and for the experimental group (β=.44, $p < .05$). The association indicated that students who scored higher on posttest self-regulation also scored higher on the posttest of critical thinking disposition at the end of this study. The other two path coefficients: pretest self-regulation to pretest critical thinking skill and posttest self-regulation to posttest critical thinking skill, in contrast, did not yield statistically significant associations in the experimental and the comparison group. In summary, self-regulation had significant effects on students' critical thinking disposition, but not on their critical thinking skills in both the experimental and comparison groups.

PERCEPTIONS ON THE IMPLEMENTATION AND USEFULNESS OF THE TWO METACOGNITIVE TASKS

The fourth research question examined the teacher's and students' (experimental group only) perception on the implementation and usefulness of the metacognitive tasks

on their critical thinking. The following section reports results of the content analysis based on the teacher's interview, students' interviews, and students' opinion survey.

Students' Perceptions on the Critical Thinking Tags

In terms of the critical thinking tags, students' opinion survey result showed that about 56 % of the students perceived the critical thinking tags as helpful, 23 % of the students consider it confusing, but manageable; and 20 % of the students regarded it as redundant (see Table 14).

Table 14
Students' Perception on the Critical Thinking Tags

Helpful			**Confusing, but manageable**		**Redundant**			**Still don't get it**
Understanding Information	Keeping Posts Concise	Informing Self Class performance	Confusing	Hard	Not Specific Enough	Unnecessary	Afterthought	
52%	3%	1%	16%	6%	1%	12%	4%	4%

Helpful

Students reflected that the critical thinking tags were helpful in three aspects including understanding information, keeping post concise, and keeping them informed of their class performance. In regard to understanding information, students expressed that the tags helped them in several areas. First, they helped students understand the discussion topics more. Students indicated that the tags guided them to be more focused on the topics, therefore, facilitated their understanding of the discussion topics. One student indicated that "they (critical thinking tags) help me think in the topics they say." Second, the tags guided students to reflect and understand their thinking process. Most students initiated a post or replied to another student's post first, and then referred to the list of critical thinking skills to select corresponding tags. Students mentioned that this process made obvious the ideas that they tried to express and the critical thinking skills that they used in their posts. For example, one student said that "they (critical thinking tags) help you learn about your thought process and how you go about figuring things out." Another student said that "I think that they make us think what we are talking about more than needed, which is good." A third student also mentioned that "I think the description for each tag is well-written and help the students decide what their comment is." From the perspective of their peers, some students showed an awareness of how the tags might help others to understand their posts. For example, one student suggested that "I think the tags help the reader to better understand your critical thinking." Third, the tags helped students understand messages posted by their peers. Students felt that the tags assisted them to identify their peers' thinking process and the processes others used to derived their ideas. Without the tags, students sometimes found it hard or confusing to read their peers' post. They found that the tags provided them with more hints to

understand others' posts. One student mentioned that "I have started to understand them (critical thinking tags) more and they helped me know how others come to their reasoning. Another student also stated that "I don't like the fact that we always have to put one, but I think it is a good idea because it helps to understand what the person is trying to say." Overall, students found that the tags increased their understanding of several pieces of information including the discussion topics, their thinking processes and other's thinking processes.

Another benefit of using the critical thinking tags is that they help keep students' posts concise and focused. Students mentioned that the tags reminded them to focus on the topics and avoid too many off-topic details. For example, one student stated that "I think they (critical thinking tags) help me keep my thoughts economized." The third benefit of the tags was that they informed students how well they performed in class, especially, in the online Socratic Seminars. Some students expressed a sense of pride when they were able to apply more than one critical thinking tags to their posts. One student mentioned that "I think they (critical thinking tags) are really important and helpful because they kind of give you more perspective and see how involved you are in the process and, most important, it lets you know if you are making sense."

Confusing, but Manageable

Although the teacher spent two class periods explaining the critical thinking skills and practice applying tags with her students at the beginning of the semester, about 1/5 of the students still expressed confusion toward the critical thinking tags and how to select the correct one to apply to their posts. Most of the responses under this coding were neutral. About 22 % of the students expressed that the critical thinking tags were

confusing, but they also indicated that the tags were manageable for them. For example, a student said that "they (critical thinking tags) were kind of confusing at first, but I think that I've got the hang of it, it gets less confusing" Some students expressed that the tasks could be less difficult if the teacher could devote more time explaining each critical thinking skill in more detail in the class. Because most of the participants in this study were novice learners of critical thinking and did not have many opportunities to use critical thinking in the past, learning the complete set of critical thinking skills in two class periods can be a daunting task for them, which is why a lot of them thought that the critical thinking tags were not specific enough for them. One student mentioned that "they're (critical thinking tags) very open ended, not specific enough."

Redundant

Another 1/5 of the students reported that applying critical thinking tags to their online posts was redundant. Those students felt that they already knew what they were trying to express in their posts and assumed that other students would be able to understand their posts after reading them. Therefore, they felt that the tags were unnecessary. For example, one student mentioned that "I don't see the point in them if people actually read your message why does it matter what tag it is"? Other students considered the critical thinking tags unnecessary because they thought they were more of an afterthought. A student expressed that "I don't think they are useful because I think a lot of people type their messages and then just find a critical think tag and post it."

Still Don't Get It

About four % of the students indicated that they were still confused about the critical thinking skills even after the second Socratic seminar. This situation was reflected in the small amount of online posts with incorrect tags applied to them and one

student's posts, which only had the "idk" tag, meaning "I don't know", applied to them. This problem showed that one critical thinking training that introduced students the critical thinking skills and how to use them as tags for students' online posts is insufficient for some students. Some students, especially those who were total novice of critical thinking might need a longer period of time and more scaffold to become familiar with the critical thinking skills. Not having enough preparation of critical thinking skills before they started applying the tags could prevent these students from making the connecting between their online discussions and the critical thinking skills.

In summary, about 56% of the students reported the critical thinking tags to be helpful. About 22% of the students found the tags confusing, but manageable, another 17 % of the students suggested the tags unnecessary; while 4 % of them still had problems with the tags. Overall, despite the mixture of feelings, the majority of students still considered the critical thinking tags beneficial for them to learn the discussion topics, understand their own thinking process, help others comprehend their posts and make sense of others' posts.

Students' Overall Performance When Applying Critical Thinking Tags

In order to understand how students performed when they applied critical thinking tags in their online discussions, the researcher randomly selected 217 (33 %) of the posts from the first (315 posts) and second (324 posts) online Socratic Seminar discussions. 217 (33 %) of the total posts should reveal enough information in regard to how students applied critical thinking tags in their posts. The descriptive analysis should reveal whether the intervention of this study, performing the two metacognitive tasks, could be confounded by extraneous variables, such as lack of sufficient training before students performed the two metacognitive tasks. The analysis revealed that some students had

problems applying critical thinking skills to their online posts. Out of the 217 randomly selected online discussion posts, students did not have any tags applied to 33 (15 %) of them and incorrectly applied critical thinking tags to 32 (15 %) of them. Of the 33 posts with missing tags, only three of them had the tag "idk" applied to them; the remaining 30 posts had missing tags because students forgot to add them. This phenomenon was confirmed in the teacher and student interviews. When the researcher asked the teacher about the missing tags on some posts during the teacher's interview, the teacher mentioned that she remembered some of her students told her that they forgot to apply tags in their posts after both the first and the second online discussions. The excerpt of the conversation is below.

> Researcher: I noticed that some posts in the online discussions have missing tags. Do you know why?
> Teacher: Ohh..I remembered some of my students told me they forgot to apply tags in their (online) posts. They forget things easily. I just told them to remember doing that in the future.

This phenomenon was also confirmed in the students' interviews. For example, the excerpt of a conversation between the researcher and a student is below

> Researcher: I noticed that you didn't put critical thinking tags in some of your tags. Can you tell me why?
> Student: I just forgot. Sometimes it's difficult to remember doing that.

Of the 33 (15%) posts with incorrect tags, the critical thinking tag, self-regulation occurred most often, followed by the inference and interpretation tags. The fact that these tags were frequently applied incorrectly by the students showed that students were still confused by these three critical thinking skills. Although students received the training to apply critical thinking tags before they started the task, the reason that some students still

had trouble with the tags was probably that under each of the six main categories of critical thinking skills there were additional four sub-categories. Despite the fact that students were required to use only the six critical thinking tags at the top level, students would still need to read through the subcategories before they were able to decide which top-level tags they could apply to their posts. In addition, both the teacher and students stated that some of the subcategories were overlapping, which caused more confusion for the students. For example, students mentioned that they perceived the sub-skill of explanation, using relevant information to support my opinion, as equivalent to the sub-skill of evaluation, offering supplementary information (that may strengthen or weakened an argument). Table 15 shows the frequency count of incorrect tags from the 33% of the 217 randomly selected posts.

Table 15
Frequency Count of Incorrect Tags from the 33% Randomly Selected Posts

Critical Thinking Tags	Analysis	Inference	Interpretation	Evaluation	Self-regulation
Frequency Count	*1*	*7*	*4*	*3*	*12*

Students' Perception on the Implementation and Usefulness of Reflection Journals

Similar to the results for the critical thinking tags, students also reported a mixture of feelings toward the reflection journals (see Table 16). About 49 % of the students considered the reflection journals useful. About 31 % of the students held a neutral stance toward the reflection journals and about 20 % of the students perceived the reflection journals unnecessary. Students, who considered the reflection journals useful, suggested that the reflection journals helped them reflect on how they prepared for each discussion topics and provided them an opportunity to contemplate on future improvements. For example, one student expressed that "the reflection journals give you a good ideas on how things are going to be and how you should proceed the next time." For students who were neutral toward the reflection journals, they reported the reflection journals as being not too difficult, but could sometimes "get into the thinking process." For example, one student indicated that "it (the reflection journals) sometimes gets into the thinking process because we do that afterwards and we sometimes forget what we did before the first Socratic Seminar." Other students considered the reflection journals redundant because they felt writing the reflection journals required the same thinking process as when they assigned critical thinking tags to their posts in the online Socratic Seminars. They felt both of the reflection journals and critical thinking tags asked them to reflect on something they already did and were both an afterthought. A student reflected that "I just remembered the reflective journal being not too difficult, but I don't see why we have to reflect again, we already did enough in the seminars (applying the critical thinking tags)."

Table 16
Students' Perception on the Reflection Journals

Helpful	No comment	Redundant
49 %	31 %	20%

Although students reported a mixture of different opinions toward the reflective journal, students' responses in the reflective journal showed that almost all of them had no problem completing the reflection journals. In the students' interviews, students mentioned that they were already familiar with writing reflection journals. They were asked to write reflection journals in this class as well as in other teachers' classes during the previous semesters, which is why none of them reported the reflection journals being confusing or challenging in their interviews or in the opinion survey.

From the Teacher's Perspective

From the teacher's perspective, the teacher's interview corroborated with students' interviews as well as responses from the opinion survey. The teacher's interview revealed that the teacher believed that the two metacognitive tasks had instructional benefits to help her students develop critical thinking. She expressed that "my students were not in the habit of thinking on their own, I think the reflection journals and the tags will give them the structure and opportunities to form the habit." When contemplating her students' reactions after she gave the first critical thinking training in

class, she expressed that "it (the critical thinking training) is like an eye-opener for them (her students). I can tell my students are excited about critical thinking and really want to use it because no one wants to be the "naïve Nancy" or "selfish Sam" (characters in the training video)."

The initial positive feedback from her students seemed to give the teacher encouragement to continue implementing the two metacognitive tasks. Although the teacher thought and believed that the two metacognitive tasks were useful and helpful for her students to learn and practice critical thinking, at the same time, she also worried that some of her students might be challenged by the complexity in the different types of critical thinking skills. In regard to the implementation of the reflection journals, the teacher explained that most of her students did not have problems completing the reflection journals because her students had many practices before this study. Her students had been required to write reflection journals for her class or classes taught by other teachers. Compared to writing reflection journals, however, the teacher noticed that more of her students were having problem applying the critical thinking tags in their online discussions. Although she tried her best to allocate two class periods to explain each critical thinking skill to her students, she felt her students either need more time or more practices to learn and practice critical thinking skills in her and other teacher's classes especially when the school environment was not promoting critical thinking. In addition, she agreed with her students that some of the critical thinking skills were abstract and can be overlapping depending on the context. She noticed that some of her students became confused and sometimes even frustrated when trying to apply the critical thinking tags. She usually helped her students by encouraging them to persist or assuring

them that they would get better at choosing the correct critical thinking skills with more practices. If her students still experienced frustration with the critical thinking tags and if time allows, she would use a specific post from that student's online discussion to show that student the thinking processes she would use to select the critical thinking tags. As the semester progressed, the teacher expressed that her students seemed to gradually grasp the critical thinking skills and became better at selecting the right critical thinking tags for their online posts.

From the teacher's perspective, she believed in the instructional potential of the two metaocgnitive tasks although she had concerns regarding the time and numbers of practices some of her students might need before they could perform these two tasks well, especially correctly tagging the critical thinking skills they used in their own online posts.

Overall, the teachers and the majority of students perceived the two metacognitive tasks as useful to students' development of critical thinking based on the teacher's interview, students' interviews and students' opinion survey. The implementation of the two metacognitive tasks was initially compromised because of the complexities in critical thinking skills. As the semester progressed, the implementation became smoother as students became more familiar with the two metacognitive tasks. The majority of students were able to successfully complete the two metacognitive tasks.

SUMMARY

This section reported results for each of the four research questions. The quantitative result showed that performing the two metacognitive tasks increased

students' self-regulation, but not their critical thinking skills or critical thinking disposition. The structural equation modeling analysis revealed that performing the two metacognitive tasks does not moderate the relationships among the pretests and posttests of self-regulation, critical thinking disposition and critical thinking skills. In addition, the structural equation modeling analysis also showed that self-regulation significantly affected students' critical thinking disposition, but not their critical thinking skills in both the experimental and comparison groups. In regard to the teacher's and students' perception of the implementation and usefulness of the two metacognitive tasks, the teacher and the majority of students considered the two metacognitive tasks as helpful, nevertheless, a few of the students also considered these two tasks as redundant because they perceived them as an afterthought. Initially some students in the experimental group were confused about the critical thinking tags, but as the semester progressed, they became better at selecting the correct tags. The teacher and students were able to successfully implement the two metacognitive tasks toward the end of the semester. The next section will discuss the results and their implications in detail.

Chapter V. DISCUSSION

In this study, classes were randomly assigned to two groups: the experimental and the comparison group. The experimental group completed two metacognitive tasks; while the comparison group was given neither of the tasks. The primary purpose of this study was to examine three aspects of this intervention. First, this study examined whether performing the two metacognitive tasks had any effect on students' critical thinking disposition, critical thinking skills, and self-regulation. Second, this study used a structural equation model to investigate the relationships among the moderator [performing the two metacognitive tasks (metacognitive grouping)], self-regulation, critical thinking skills and critical thinking dispositions. Third, because the effects of the two metacognitive tasks depended on the teacher's and students' actual implementation and perception of them, this study also examined how the teacher and students implemented and perceived the usefulness of the two metacognitive tasks. This study answered the following research questions.

Question 1. What are the effects of an intervention that involved metacognitive tasks on mean scores of self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes?

Question 2. Does an intervention that involved metacognitive tasks introduce any structural differences in the relationships among students' self-regulation, critical thinking skills and critical thinking disposition

in online Socratic seminars for high school social studies classes? If so, in what way

Question 3. What are the relationships among students' self-regulation, critical thinking skills and critical thinking disposition in online Socratic seminars for high school social studies classes?

Question 4. How do the teacher and students perceive the implementation and usefulness of an intervention that involved metacognitive tasks?

The following section will present the following three aspects of the study: (1) salient details of the findings for each research question (2) limitations of the study, and (3) recommendations for future research.

SUMMARY FINDINGS OF RESEARCH QUESTION 1

Before the beginning of the study, the researcher predicted that performing the two metacognitive tasks would produce significant effects on students' self-regulation, critical thinking skills and critical thinking dispositions after controlling for the effects of the three pretests (pretest of self-regulation, pretest of critical thinking disposition, and pretest of critical thinking skills). The multivariate analysis of covariance yielded a mixture of statistically significant and insignificant results. Univariate analyses revealed that performing the two meatcognitive tasks caused a significant mean difference in students' self-regulation between the experimental and the comparison groups, but it did not cause any significant mean differences in students' critical thinking disposition or students' critical thinking skills.

SUMMARY FINDINGS OF RESEARCH QUESTION 2

Based on previous literature that suggested close relationships among self-regulation, metacognition, and critical thinking (Dewey, 1933; Garrison, 2002; Lin, 1999; Miller, 1978; Schraw, Crippen, & Hartley, 2006; Zimmerman, 1990, 1995, 2008), this study hypothesized that performing the two metacognitive tasks would significantly moderate the relationship between students' self-regulation and critical thinking. The result showed that performing the two metacognitive tasks did not influence the relationship between students' self-regulation and critical thinking skills, or the relationship between student's self-regulation and critical thinking dispositions. This result showed that the relationship between students' self-regulation and critical thinking skills, and the relationship between student's self-regulation and critical thinking dispositions did not depend on whether students performed the two metacognitive tasks. The effect of self-regulation on students' critical thinking skills and disposition was statistically the same for students in both groups whether they performed the two metacognitive tasks. Nevertheless, both the pretest and posttest of self-regulation showed a strong path to critical thinking disposition. In the experimental group, the coefficient between self-regulation and critical thinking disposition was shown to increase from .43 in the pretest to .44 in the posttest, while the standardized path coefficient decreased from .51 in the pre test to .30 in the comparison group. Such findings implied that during the study, the relationship between self-regulation and critical thinking disposition became stronger in the experimental group, while it became weaker in the comparison group. The result showed that performing the two metacognitive tasks seemed to strengthen the relationship between self-regulation and critical thinking disposition in the experimental

group, but not in the comparison group although this effect was not statistically significant in the structural equation model.

SUMMARY FINDINGS OF RESEARCH QUESTION 3

The third research question hypothesized significant relationships between students' self-regulation and critical thinking skills, and between students' self-regulation and critical thinking disposition in both the experimental and the comparison groups. The hypotheses were: (1) Self-regulation is a significant predictor of student's critical thinking skills and (2) Self-regulation is a significant predictor of student's critical thinking disposition. The result showed that self-regulation was a significant predictor of students' critical thinking disposition, but not students' critical thinking skills for both the experimental and comparison groups. This result indicates that students' level of self-regulation did not predict their level of critical thinking skills for both groups.

The following section discusses the findings in detail.

DISCUSSION OF RESEARCH QUESTIONS 1, 2 & 3

Effects of Performing the Two Metacognitive Tasks

The close relationships among metacognition, self-regulation and critical thinking have been reported and studied in previous literature, such as Kuhn's (1999) and Willingham's (2008) studies on the relationship between metacognition and critical thinking, Facione's (1990, 1996, 200, 2007) studies on the relationship between self-regulation and critical thinking, and studies on the relationship between metacognition and self-regulation (Fincham & Cain,1986; Paris & Oka, 1986; Zimmerman, 1994,

1995). In regard to the relationship between metacognition and self-regulation, scholars have found metacognition to be reciprocal to individual self-regulation (Fincham & Cain, 1986; Paris & Oka, 1986; Zimmerman, 1994, 1995). While metacognition controls an individual's thinking process, self-regulation puts the thoughts into action (Wilen & Phillips, 1995). Studies by Fincham and Cain (1986) and Paris and Oka (1986) have shown that students with a higher level of metacognition also show a higher level of self-regulation. They found that students with higher metacognition used more cognitive strategies and tended to persist longer on their learning tasks. Studies by Zimmerman (1994, 1995) also found that students who have higher metacognition tended to have higher self-regulation. In this study, results corroborated with existing literature and confirmed the benefits of the two metacognitive tasks on high school students' self-regulation. Student interviews and opinion surveys also showed that the two metacognitive tasks helped students to think about the expectations of their learning tasks and guided them to modify their performances accordingly. For example, many students in the opinion survey mentioned that the reflection journals made them reflect on how they collected and analyzed information. It also helped them to reflect on their past thinking processes and compare these processes against possible future modifications. When she talked about her experiences of applying the critical thinking tags in her online posts, one student expressed that

> I think it (applying critical thinking tags) is a really great way to help me understand what I am thinking, like when I am writing if I know which tags I am using, it actually helped me understand what I am writing. Usually I would look at the tag first, and then I would have an idea and then I looked back at the list of tags to see which one fits my idea and then I kind of modify my idea to make it fit the tag. It helps me shape my thinking process.

Although performing the two metacognitive tasks increased students' mean scores of self-regulation in the experimental group, nevertheless, it did not cause any differences

in students' scores of critical thinking skills or critical thinking dispositions between the two groups. In addition, the results indicated that the relationships between self-regulation and students' critical thinking skills, or between self-regulation and students' critical thinking disposition, were statistically the same in both groups. These insignificant effects were in conflict with previous literature and could be explained in several aspects. First, Kuhn (1999), from the developmental perspective, maintained that the development of critical thinking should be based on previous experiences and development. Compared to adults and older adolescents, children were not usually as mentally prepared to master critical thinking in the short term, especially when critical thinking implies a set of more complex and higher level cognitive skills. He argued that the effects of instructions that were designed to teach critical thinking could sometimes yield no significant results because students had not accumulated enough past experiences, or developed the prerequisite cognitive skills, to learn critical thinking. In his studies, Kuhn (1999) found that most young children were limited in their conceptualization of certain types of thinking, such as making causal inferences. In addition, even if an individual is engaged in a thinking process, he or she could be thinking about his or her own thinking in an uncritical manner (Lipman, 1991). Lipman (1991) emphasized that one's metacognition must be "self-correcting' before it can be qualified as critical thinking. Although an individual was required to think or voluntarily thought about his or her thinking, if he or she was not critical in their thinking process, he or she was still not engaged in critical thinking. Therefore, for instructions that promote critical thinking to be successful, prior experiences and prerequisite cognitive development are essential. In this study, the insignificant effect of the two

metacognitive tasks could be because the participants might perform the two metacognitive tasks without the prerequisite experiences or cognitive skills that help them to think critically. Before the study, the teacher expressed her concerns that her students were not in the habit of thinking on their own. In addition, she worried that the existing required curriculum and her students' past courses did not provide her students with sufficient preparation to use critical thinking. Although past studies that examined the effects of tagging (Cho & Jonassen, 2002; Scardamalia & Bereiter, 1996; Schellens, et al., 2009) or writing reflection journals (Simpson & Courtney, 2007) on students' critical thinking yielded significant results, the participants in these studies were either undergraduate students, graduate students or experienced learners of critical thinking. For novice learners of critical thinking, such as participants in this study, it is possible that the insignificant results were caused by their developmental stage of critical thinking. This phenomenon was reflected in some students' confusion and frustration toward the list of critical thinking skills when the teacher first presented these skills to her students. Although only 65 (15 %) of the posts out of the 217 (33% of the total posts) that were examined by the researcher had wrong tags applied to them, the teacher and students mentioned that some of the students in the experimental group showed confusion and even frustration when applying critical thinking tags to their online posts. This confusion and frustration persisted through the second online Socratic Seminar discussion. Due to the tight schedule, the teacher felt that she only had enough time to generally encourage her students to keep trying, rather than give them one-on-one or group consultations to help them. She mentioned that some of her students would ask their peers for help, but majority of them might struggle on their own or give up. Students' interviews and

responses in the opinion survey also corroborated these students' feelings of frustrations. When students wrote their opinions on the critical thinking tags in the exit opinion survey, some of them wrote "I still don't get it," or "they are still confusing to me." Students in the interviews mentioned that they got frustrated with the critical thinking tags and they knew that other students also had the same problem. They also mentioned that the teacher did encourage them to try their best, but the teacher did not have enough time to discuss their individual posts with them all the time. One student expressed that

> When I typed it (critical thinking tags) out and then I looked at the tag, I feel what I thought initially was true was not true, so I can't put out great information. Sometime it took me hours, I mean, I want to apply the right tag. Ms. R. (the teacher) explains that it is quite important that we pick the right information and keep trying our best. I think what it comes down is that others know what to expect and what to do. After all, this is a difficult class, they (teachers) don't have time to explain that much. If they (students) have questions they will ask their classmates.

Because of the limited class time, the complexity of critical thinking and the students' prior experiences with critical thinking, the insignificant effects of performing the two metacognitive tasks on students' critical thinking skills and disposition might be because the participants' in this study did not have sufficient prior preparation or development for the two metacognitive tasks to show any significant effects. For the participants of this study, the effects of performing the two metacognitive tasks might take a longer time to show when compared to more advanced or more experienced learners of critical thinking.

The second possible explanation of the conflicting results could be that students do not develop critical thinking in a vacuum (Kuhn, 1999). They need a nurturing and supportive environment to learn and develop their critical thinking (Bulletn , 1998; Gokhale, 1995; Kuhn, 1999; Shamir, Zion, & Spector_Levi, 2008; Simpson & Courtney,

2007; Wilen & Phillips, 1995). In regard to the supporting environment, one line of existing literature focused on supporting environment facilitated by teachers, while the other line of literature emphasized on peer collaborative environment sustained by students. In regard to teacher-facilitated supporting environment, Newman (1991) and his research team examined teacher's instructional and pedagogical strategies to foster metacognition and critical thinking. They maintained that teacher modeling could provide the required environment to achieve these two goals. The three most important characteristics of such modeling are that (1) the teacher often models his or her thinking process through problem (2) the teacher shows interests and engagement in students' ideas and approaches to solve problems and (3) the teacher resonates with the challenges students encountered when solving problems. During the study, the researcher observed the classes about once a week. Based on the researcher's observation notes, the teacher rarely demonstrated any of the three characteristics in class because of the limited class time and the tight curriculum. In addition, the required curriculum for this class did not demand much higher-order thinking. When the teacher discussed her ideas to introduce critical thinking to her students with the researcher, the teacher mentioned that contents in the textbook mainly involve rote memory, which motivated her to introduce the three Socratic Seminars to help her students develop their critical thinking. In addition, she expressed that the online learning content management system and online Socratic seminars would help release some of the pressure from the tight class schedule because students can complete majority of the activities outside of the class time. Most of the times when the researcher observe the classes, the teacher would devote majority of the class time to the required curriculum, except when she taught the critical thinking training

at the beginning of the semester and facilitate the in-class Socratic Seminars. Overall, the setting of this study did not seem to provide the teacher enough time and flexibility to often demonstrate the three characteristics of teacher modeling as delineated by Newman and his team (1991).

In regard to peer support environment, studies by Gokhale (1995) and Shamir and others (2008) found that peer support environment can help students develop their critical thinking skills through peer modeling their thinking processes to others and discussing problems with peers. In the study, both the students and teacher reported that some students asked their friends when they were confused about which critical thinking skill tag(s) to apply to their online posts. When examining students' online discussions in the Q & A forum, the researcher only found 5 messages out of the total 639 messages that discussed the critical thinking tags or reflection journals. These messages either included some students' complains about the critical thinking tags being too difficult or other students' responses to generally encourage them. Nevertheless, none of the discussions were of peer modeling or collaborative interactions to help each other to solve problems with the tags. This lack of peer support environment also seemed to carry over in the classrooms. Other than the first training session that introduced critical thinking and taught students how to apply critical thinking tags, the teacher was not able to allocate extra class time to show or discuss students' online Socratic Seminar discussions in class again during the semester. Because no extra time was allocated to the online Socratic Seminars in class, some students might ask their peers problems about the critical thinking tags outside of the classroom. Nevertheless, they did not have the opportunity to model their critical thinking processes or engage in collaborative discussions to solve

problems together in the classroom. In other words, the two metacognitive tasks were implemented without the required supportive environment either from the teacher or peers to help students develop their critical thinking skills or disposition through the semester. Because the lack of peer or teacher support of the two metacognitive tasks in the classroom setting, students could also easily lose sight of their values. Kuhn (1999), in his study, found that simply teaching critical thinking to students through metacognition is not enough. Most importantly, students need to believe in the value of thinking about their thinking when learning critical thinking. Otherwise, their thinking processes would only stay at the superficial level without having the power to incur any critical changes in how they think. In this study, although some students saw benefits of the two metacognitive tasks to help their critical thinking, this perception could gradually weaken if the school context overall could not support this type of thinking habits. Based on the researcher's observation notes, the teacher's interview and students' interviews, the researcher found that the context of this study, from the overall school environment to classes taught by the teacher, provided minimum facilitation or supportive culture to support and sustain students' development of critical thinking and metacognition. Without the follow-up facilitation or encouraging culture that acknowledged the value of developing these two abilities, students' beliefs in their benefits as well as habits to implement them could become harder to maintain.

The third possible explanation of the conflicting results is that participants of this study often showed signs of forgetfulness during the course of this study. Before the teacher set up student login accounts to the online learning content management system, she already anticipated that her students would have problem remembering their

accounts. She, therefore, asked them to write down their account information and turned in a copy of the written login accounts to her. Through the semester, students constantly requested their account information from the teacher. In addition, they seemed to forget about the existence of the online learning content learning management system by the second half of the semester. The researcher and the teacher noticed that the participation rate in the Q &A forum in the online learning content management system dropped tremendously one month after students started using it. In addition, when the teacher reminded her students to participate in the first online Socratic Seminar discussion as part of the course requirement, most of her students seemed lost. An excerpt from the researcher's observation notes recording this event is below.

> The teacher is announcing the first assigned online Socratic Seminar discussion. Students are silent for a minute and then students are murmuring among themselves "what online classroom (this is how the classes address the online learning content management system)?" The teacher responded "I showed you the online classroom at the beginning of the semester, remember? The website is something like www…….. and you need to log in. Remember?

Although fewer students forgot about the online learning content management system when the teacher announce the second online Socratic Seminar discussion, some students still forgot about it. When students wrote their perceptions of the online learning content management system in the exit opinion survey, about 5 % of them responded that they totally forgot about the online learning content management system because they got busier toward the end of the semester. This phenomenon corroborated the rapid drop of participation rate in the voluntary Q &A forum in the online learning content management system toward the end of the semester. As the majority of students only visited the online learning content management system when they were required to

participate in the two online Socratic Seminars and the teacher rarely showed the online learning content management system in class again after the first training, some of the students probably forgot about the online learning content management system and majority of them could gradually forget the main role critical thinking skills played in the online learning content management system after the second required online Socratic Seminar. Because students were not reminded of the online learning content management system and its relationship with critical thinking again before they completed the posttests of critical thinking skills and critical thinking dispositions, they could have difficulty connecting their responses in the posttest of critical thinking with their critical thinking dispositions or the critical thinking skills they used in the online learning content management system. In addition, students could become used to providing only straight answers when asked to solve a problem based on their previous experiences taking similar writing tests. These prior experiences could explain why majority of them only provided their answers on the posttest of critical thinking skills without further elaboration on their thinking processes. Because these types of short and direct answers rarely reflected the critical thinking skills listed in the grading rubric, the majority of students received lower scores on their critical thinking skills posttests. Compared to students' responses in the pretests of critical thinking skills right after the critical thinking training, their responses in the equivalent posttests showed less complicated and less elaborated thinking processes although almost all of them felt that they became more critical about their thinking in the exit opinion survey. This conflicting result showed that students could have forgotten about the online learning content management system and its relationship with critical thinking when they were not

reminded of them again before they took the posttests of critical thinking skills and disposition. Their forgetfulness might cause them to forget about critical thinking skills and critical thinking dispositions and, therefore, forgot to use or self-report them in the posttests of their critical thinking skills or dispositions although they were getting better at it.

The fourth possible explanation of the conflicting results is that the insignificant effect of the two metacognitive tasks may have stemmed from implementation issues of the posttests. The results could be confounded by students' impatience when taking the posttests of critical thinking skills and critical thinking disposition. When students first started the study, they were all freshmen in high school. Their attitude toward the teacher and school tasks was generally cooperative and compliant. The students also felt little pressure from their classes. Although they knew that some of the assignments they did in class (e.g. complete the critical thinking writing report at the beginning of the semester) were for this study, they were very willing to help at the beginning of the semester. When students had completed the three pretests, they knew the purpose of the pretests was to assess their existing level of self-regulation, critical thinking disposition, and critical thinking skills. They knew they were not going to be graded for these assessments because these tasks were for a research study. Nevertheless, they still spent sufficient time to complete each of the three pretests in class.

By the end of the semester, their attitude toward the assessment seemed to dramatically change due to increased workload and concern about the 10 percent rule[1]. Since participating students were divided into the experimental group and the comparison group, to be fair to all students, the teacher decided not to hold her students accountable for their responses in the posttests. In addition, other more urgent school duties seemed to cause the participating students to lose interest in the study as the semester progressed. When completing the posttest of self-regulation survey, students did not seem to show any abnormality, and they completed the survey in about 15-30 minutes. Perhaps because the posttest of self-regulation was completed first of the three posttests, participating students were still able to complete it without losing patience. Nevertheless, they started showing impatience when they filled out the critical thinking disposition survey the following day. The situation worsened even more on the third day when they did the posttest of critical thinking skills. Students began to demonstrate impatience when they did the posttest of critical thinking disposition survey; their impatience seemed to increase when they completed the posttest of critical thinking skills. The posttest of critical thinking skills seemed to elicit the greatest signs of impatience from students because it was the last posttest to be administered to students and it took longer to complete.

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[1] 10 percent rule in Texas derived from the Texas House Bill 588 passed in 1997. The rule grants Texas high school graduates who graduated in the top ten percent of their high school class automatic admission to all state funded universities.

Furthermore, it required more high-level thinking skills compared to the other two self-report survey instruments. Compared to students' responses in the pretest of critical thinking, their responses in the equivalent posttest tended to be shorter and less elaborated on the critical thinking skills they used in the report. The reason for this difference may be due to the fact that toward the end of the semester, students became more concerned about their grades in other classes and experienced higher levels of anxiety related to their need to catch up on late projects. Although the teacher allocated the same amount of time for her students to complete the posttest of critical thinking as she did for the pretest, most students rushed through the posttest so that they could use the rest of the time to catch up with other school work. Based on the researcher's observation notes, students started submitting their posttest of critical thinking skills, or switching to another task about fifteen minutes after they received the posttests. The majority of students spent 20-25 minutes completing the posttests and about 3 % of them used 30-35 minutes to complete the posttests. Compared to the time when the majority of students spent the full fifty minutes or more to complete the pretests of critical thinking skills, students' haste when completing the posttests may explain why their responses in the posttests were of much lower quality and therefore, received much lower scores than those in the pretests. In the posttest of critical thinking disposition, students used relatively shorter time to complete the survey compared to the time they spent on the equivalent pretest of critical thinking disposition. As students experienced more pressure from the course work and the10 percent rule, their haste when completing the posttests of critical thinking skills and disposition could have confounded the effect of the

two metacognitive tasks on student's critical thinking skills and their critical thinking disposition.

Thus, the insignificant effects of performing the two metacognitive tasks on students' critical thinking skills and disposition that were in conflict with the researcher's hypotheses and existing literature could be explained from several perspectives. From the developmental perspective, participating students in the experimental group were not able to demonstrate significant increases in their critical thinking during the course of this study because they might lack the required prior experience or development of critical thinking before and during this study. Secondly, the study context did not provide participating students with the required teacher or peer support to develop their critical thinking. Third, participating students tended to be forgetful, especially about more complicated things such as critical thinking skills. Because students were not reminded of critical thinking or the online learning content management system right before they took the posttests of critical thinking, they may have forgotten to show their critical thinking processes in the posttest of critical thinking skills, or accurately self-report their critical thinking dispositions. Fourth, results of the posttests of critical thinking skills and disposition could be confounded by implementation issues. Students were impatient to complete these two posttests because they knew that they were not going to be graded for any of the posttests. They seemed more concerned about the 10 percent rule or about using the remaining time to catch up with other school work than performing well in the posttests of critical thinking skills and disposition. In summary, the insignificance of the direct or moderating effects of performing the two metacognitive tasks on students' critical thinking skills and critical thinking disposition could be caused by four main

factors: (1) developmental stages of the students and the nature of critical thinking, (2) the existing curriculum, (3) students' forgetfulness and (4) implementation issues.

The following section summarizes the findings as regards the relationships among self-regulation, critical thinking skills and critical thinking disposition in both the experimental and comparison groups.

Relationships among Self-regulation, Critical Thinking Skills and Critical Thinking Disposition in Both Groups

In regard to the relationship between self-regulation and critical thinking disposition, the findings showed that self-regulation is a significant predictor of students' critical thinking disposition. Previous literature showed that self-regulation included both the willingness and the action to regulate one's cognition when necessary (McManus, 1998; Schraw, Crippen, & Hartley, 2006). According to McMahon and Oliver's (2002) model of self-regulation, self-regulation is composed of the cognition domain that controls metacognition and forms self-monitoring strategies, and the affective domain that develops self concepts and initiates motivation and volition control strategies. Their model implies that a learner with higher self-regulation could also have higher motivation to exert volitional control strategies. In this study, students with higher self-regulation may have had better control over their affective domain and, therefore, had the ability to motivate themselves to use critical thinking skills. The three categories of data-the teacher's interview, students' interviews, and researcher's observations-indicated that students were excited to learn critical thinking and took pride in knowing that they would have opportunities to use critical thinking in their world geography and culture classes

after the critical thinking training. In the training video, there were three characters: "Naïve Nancy," "Selfish Sam," and "Fairminded Fran." All the students agreed that they did not want to be either the "Naïve Nancy" or "Selfish Sam" after watching the training video. Once in a while, throughout the semester, the teacher also mentioned these three characters to motivate her students to use critical thinking. This type of approving environment built a good foundation for the students to appreciate and see the benefits of critical thinking. Although the required supporting teacher facilitation (e.g. the teacher modeling critical thinking in the classroom) or peer collaboration (e.g. peers discussing problems in regard to applying the tags) to promote students' critical thinking skills, seemed to be absent in the research setting, students who considered critical thinking a valuable personal trait could persuade themselves to become more willing to use critical thinking, especially those students who already had high self-regulation. Therefore, the findings supported the hypothesis that students with higher self-regulation also developed higher critical thinking dispositions through the course of the study despite the lack of substantial instruction support from the teacher to help them to promote their critical thinking skills.

The relationship between self-regulation and critical thinking skills, nevertheless, was not significant. According to other scholars, who investigated the relationships among the three constructs (Facione, 1990, 2007; Facione, Facione, & Giancarlo, 1996, 2000), critical thinking is composed of two sub-components: critical thinking skills and critical thinking disposition. In addition, among the critical thinking skills, self-regulation was one of the six sub-skills of critical thinking. Based on Facione and his colleagues' framework of critical thinking, the three constructs of self-regulation,

critical thinking skills and critical thinking disposition, should be highly correlated with each other. The insignificant relationships between self-regulation and critical thinking skills could possibly be explained by some of the same issues that confounded the effects of the two metacognitive tasks as discussed earlier. The first potential issue could come from problems in the implementation of the posttests of critical thinking skills and critical thinking dispositions. When students were taking the posttests of critical thinking skills and critical thinking dispositions, especially the posttests of critical thinking skills, they were not putting forth the same effort and concentration as they did when they took the equivalent pretests. This problem was reflected in the lower scores of students' posttests of critical thinking skills. The second potential issues could involve the developmental stages of the participants and the nature of critical thinking. Learning to think critically usually takes time and reflective practices with many examples in various situations (Ennis, 1993). The effects of any intervention might take longer to show themselves if the participants were new to, or had fewer previous experiences with, critical thinking or metacognition. In addition, critical thinking is composed of a set of interdependent skills (Ennis, 1993). Although performing the two metacognitive tasks promoted students' self-regulation in this study, the association between self-regulation and critical thinking skills could be compromised if students did not have enough prior preparation or experiences with the other five subsets of critical thinking skills. Although the participants of this study, especially the students in the experimental group, had higher self-regulation toward the end of the semester, they might not have necessarily increased their skills in the other five sub-skills of critical thinking during the course of this study. Although the participants of this study were found to be motivated to use critical thinking skills, this

willingness did not promote their critical thinking skills if they did not have enough preparation or have the required environment to foster these skills. These insignificant relationships, though contradictory to the existing framework, could be accounted for when considering the problems in the implementation of the posttests, characteristics of the participants, and limitations in the research setting.

The following section will discuss findings from the fourth research question.

SUMMARY FINDING AND DISCUSSION OF RESEARCH QUESTION 4

The fourth research question examined the teacher and students' perceptions of the implementation and usefulness of the two metacognitive tasks. The purpose of this question was to first understand the teacher's and students' attitude toward the two metacognitive tasks, and then use that information to triangulate the actual implementation of the two tasks. According to the results of the teacher and students interviews, as well as the student opinion surveys, about 56% of the students considered the critical thinking tags helpful and beneficial. About 22% of the students considered the tags confusing, but manageable, and about 17 % of the students perceived the tags as redundant or unnecessary. The other 4 % of students still indicated problems with the tags. In regard to the student reflection journals, about 49% of the students had a positive attitude toward the reflection journals and considered them useful. About 31% of the students had a neutral stance toward the reflection journals, and 20% of the students considered the reflection journals to be redundant. The result shows that the majority of the students perceived the two metacognitive tasks as being useful to develop their critical thinking. From the teacher's perspective, she believed that the two metacognitive

tasks could help her students to develop critical thinking skills, which she considered to be weak among her students before the study. Although the teacher welcomed the intervention, her concern was that performing the two metacognitive tasks might be too much extra work for her students, considering the amount of required curriculum that she had to cover during the same semester. In addition, she worried that some of her students might feel confused by the different critical thinking skills, especially when her classes considered some of the critical think skills to be too abstract for them or to overlap with each other. When examining student's responses of the reflection journals and the students' online Socratic Seminar discussion, the researcher found that all of the students in the experimental group were able to successfully complete the reflection journals. This phenomenon of success was probably due to the students' previous experiences in writing reflection journals for other classes. These past experiences familiarized students with the thinking process involved in completing a reflective journal. In regard to applying the critical thinking tags, the researcher randomly selected 33 % of the total posts to examine how students applied the tags in their online posts. Out of the 217 randomly selected posts, students did not have any tags applied to 33 (15%) of them and incorrectly applied critical thinking tags to 32 (15 %) of them. This pattern shows that about 15 % of the students were still confused about the critical thinking skills that they used for the tags. In addition, about 15 % of the students forgot to apply the tags, which they reported to the teacher or mentioned in the interviews. Overall, the teacher and about 56% of the students perceive the application of critical thinking tags to their online posts as useful to develop their critical thinking and had no problem implementing the tags. The teacher and about 49% of the students perceived the reflection journals as useful to develop their

critical thinking, and all of them had no problem completing these journals. Although the quantitative analysis showed that performing the two metacognitive tasks had no significant direct effect on students' critical thinking and no significant moderating effect on the relationship between self-regulation and critical thinking, the positive feedback from the teacher and students showed that performing these two tasks might still be beneficial to promote critical thinking among students.

In regard to future design improvement of the two metacognitive tasks, one suggestion would be to create a more supportive environment throughout the semester. Since one training session on critical thinking and the application of critical thinking tags to online posts might not be sufficient for novice learners of critical thinking, a peer support environment facilitated by the teacher might compensate for this issue. Also, the teacher could recommend that students target a critical thinking skill before they compose their online posts, as opposed to writing the posts first and then applying the critical thinking tag(s). In this way, students would be required to not only think about their thinking, but also to regulate their thinking in order to accomplish the assigned task. This recommendation could also eliminate some student's impressions of the tags as an afterthought. The last recommendation is to seek administrative support in order to allocate more time to promote critical thinking among students. If the teacher was permitted to have a more flexible curriculum, she might be able to devote more time and energy to help her students to develop their metacognition and critical thinking.

LIMITATIONS OF THE STUDY

The limitations of this study mainly came from the challenges of doing research in a public high school setting. In this section, two limitations of the study will be

presented. First of all, the inflexible required curriculum and the tight class schedule prohibited the teacher from allocating more time to the promotion of students' critical thinking and metacognition. Although the teacher saw the value of, and believed in, the benefits of the two metacognitive tasks and critical thinking for her students, she was not able to devote more time or energy to these skills due to her existing workload and the curriculum requirement. These two limitations in the past and in the present caused students to start this study without much experience in thinking on their own or in practicing critical thinking. The effects of the two metacognitive tasks could be compromised if participating students were not in the habit of thinking on their own or were not able to understand how to think critically before they started the study. In addition, the teacher was too busy covering the required curriculum to spend sufficient time scaffolding or helping her students to solve any difficulties that they encountered when doing the two metacognitive tasks. The tight schedule also seemed to prevent the teacher from organizing or sustaining any peer support mechanism for her students. On the students' end, they could have easily forgotten to practice or use critical thinking because it was not embedded in their regular curriculum. The tight class schedule and required curriculum also deprived them of opportunities to use critical thinking or to discuss the critical thinking problems with their peers in the classroom setting. Since the required teacher or peer support environment was lacking, the two metacognitive tasks could have become independent of the overall classroom context and, therefore, students were left to practice critical thinking or solve any problems with the two metacognitive tasks on their own. The purpose of the metacognitive tasks to promote their critical thinking could have become diluted as the semester progressed. The second limitation

was the implementation issues of the instruments. In order to be fair to all students, the teacher was not able to assign grades to her students' posttests. Students tended to dismiss the posttests because they could spend the same time completing the posttests on their school related projects, which would give them credit for the 10 percent rule. In addition, both the participants and non-participants in this study had to stay in the same room when the participants were completing the posttest. The attitudes of the participants on the posttests could have, therefore, been affected by the non-participants. Despite these limitations, the following section will provide recommendations to improve similar research in the future.

RECOMMENDATIONS FOR FUTURE RESEARCH

For future research, there are several recommendations based on results of this study and existing literature. The first recommendation is to restrict students to assign a critical thinking tag(s) before they write their posts in the online discussion forum. In this study, about 99 % of the students stated that they usually wrote their posts before they applied critical thinking tag(s) to their messages. This habit explained why some students perceived critical thinking tags as an afterthought. Only two students in the experimental group indicated that they targeted specific critical thinking skills before they wrote their messages. For the majority of students in the experimental group, metacognition on their critical thinking skills came after they had completed their posttests, while for the two students, who targeted specific critical thinking skills before they composed their posts, metacognition on their critical thinking skills was proactive and guided their performances on the posttests. When the researcher compared the quality of posttests of

these two students to the rest of the group, these two students who took the proactive approach produced higher quality writing report in their posttests of critical thinking skills than those who picked the critical thinking tags after they completed their online posts. In Scardamadia and Bereiter's (1996) study, the thinking tags were built into the online forum and the participants were forced to select a tag before they can write a post. They found this proactive reflective thinking promoted student's critical thinking skills because it helped students think about their critical thinking before they started writing. In this study, nevertheless, students had to type their own critical thinking tags because they were new to critical thinking. The researcher hypothesized that having the opportunity to refer to the complete list of critical thinking skills and to read the detailed explanations before students select their posts would help them to select the most accurate tags. Because of this design, students were also provided the option to select a critical thinking tag either before or after they wrote their post. For future researchers who are interested in pursuing this line of research, they might want to examine impacts of the sequence to apply the tags on students' development of critical thinking. Another recommendation for future research is related to compensations for the participants. The implementation of the study instruments was confounded by the fact that students were not rewarded for participating in the study. In addition, both participating and non-participating students were in the same classroom when participating students completed the instruments. If the participating students were rewarded in certain way or if they were separated from the non-participating students when they completed the instruments, they may have been less influenced by non-participating students and may have been more motivated to complete the instruments well. The third recommendation is to extend

the duration of the study. The development of critical thinking takes time (Ennis, 1993), but very few studies investigated effects of instructional interventions on students' development of critical thinking over a long period of time (Norris, 1985, Ennis, 1993). Take this study for example, although the quantitative analysis revealed insignificant effects of performing the two metacognitive tasks on students' development of critical thinking, student's online discussions showed increased complexity and usage of critical thinking skills. Because the result of this study may have been confounded by the developmental issues of participants, implementation of the instruments or limitations in the research setting, long term implementation of the metacognitive tasks along with a more supportive online learning community and in-class community might reveal more significant effects. The fourth recommendation is to require both the participating and non-participating students to complete all of the pretests and posttests whether they and their parents submitted the consent forms. In this study, the posttest of critical thinking skills was confounded by the fact that participating students' attitude toward the posttest was influenced by the non-participants. If all students were required to complete all of the instruments and were held accountable for their performances in the pretests and posttests, potential implementation issue might have been reduced to a minimum. The fifth recommendation is in regard to professional development for the teacher (s). The intervention of this study derived from the teacher's perceived need to promote her students' critical thinking. Nevertheless, she was not able to provide a supporting environment or to facilitate a peer support environment to sustain her students' learning of critical thinking in her classroom due to the required curriculum and limitations in the school. This issue calls for professional development trainings to help teachers to find

ways to promote students' critical thinking in the face of these obstacles. Although teachers usually have limited time and space to include critical thinking in his or her required curriculum, if future researcher can provide teachers with professional trainings on critical thinking before the study begins or regularly after school, teachers may have more support and resources to embed more critical thinking related modeling or instructional activities in his or her regular classes. Lastly, participants of this study all came from the same school and the participating classes were taught by the same teacher. A larger and more diversified group might yield clearer findings of the effects of the two metacognitive tasks. Results from a larger and more diversified group would also justify for wider applications of the two metacognitive tasks in high school world geography and culture classes. The sixth recommendation for future research is related to the instruments. Although essays with open ended questions could be more valid to assess students' critical thinking skills compared to multiple choice questions (Ennis, 1993), in this study, the open ended questions, nevertheless, gave students an option to provide short answers that failed to elaborate the critical thinking skills that they used to solve the problems. One possible recommendation to solve this issue might be using high to medium structured essay tests similar to the Ennis-Weir Critical Thinking Essay Test (Ennis, 1993). In the Ennis-Weir Critical Thinking Essay Test, students are presented with an argumentative passage that has specific built-in errors. Students are required to appraise the passage and justify their reasoning processes within a pre-defined context. Students' answers are then graded against a rubric that delineates the quality of critical thinking demonstrated in their answers. Another possibility is to assess students' development of critical thinking skill in the online discussions where students

demonstrated their critical thinking skills in its natural setting. In Garrison's (1992) framework, he defined five stages of critical thinking, including problem identification, problem definition, problem exploration, problem evaluation/applicability, and problem integration. Within the stages, he delineated each category of critical thinking indicators, such as novelty or justification. Future researchers who are interested in investigating students' development of critical thinking skills through students' online discussions might also use Garrison's model as the coding scheme to analyze students' development of critical thinking.

CONCLUSION

This section summarizes the research findings and discusses their implications. This section also elaborates on the limitations of this study and suggests areas for future research. This study extended the existing literature in three aspects. First, this study examined the effect of metacognition on students' self-regulation and critical thinking. Second, this research investigated effects of metacognition as a moderator of the relationships between self-regulation and critical thinking integratively. Third, this study investigated the relationship between self-regulation and critical thinking in both the experimental and comparison groups. Lastly, this study investigated the design and implementation of the two metacognitive tasks. Results of this study confirmed that performing the two metacognition tasks had significant effects on students' development of self-regulation. However, due to the limitations imposed by the research environment, implementation of the research instrument, and characteristics of the participants, this study yielded insignificant results of the effect of performing the two metacognition tasks

on students' critical thinking and its moderating effect on the relationship between self-regulation and critical thinking. Despite the mixture of effects of the two metacognitive tasks, the teacher and students interviews, as well as the opinion surveys revealed the potential of the two metacognitive tasks to help students to develop their self-regulation and critical thinking. Over 95% of the students expressed that they enjoyed the online Socratic Seminars and felt that the seminars helped them to become more critical thinkers because they had opportunities to learn the same discussion topic from multiple perspectives and to practice their critical thinking. Having the opportunity to share their ideas and to modify them through the course of the discussions also made them more critical of their thinking. About 56 % of the students felt the critical thinking tags helped them to understand their thinking process, to assist others to understand their posts, and to keep them focused on the discussion topic. About 49 % of the students felt that the reflective journal made them reflect on their past thinking processes and learning strategies. When students were writing the reflection journals, they also felt that some of the problems in their thinking process and learning strategies were made more obvious, which helped them in the future adjustment of their thinking processes and strategies. This research confirmed the value of the online Socratic Seminars in students' development of critical thinking. In addition, this study showed the effect of the two metacognitive tasks on students' self-regulation and potential to develop students' critical thinking. Teachers who are interested in implementing the two metacognitive tasks to develop their students' critical thinking in the future could allocate more time and energy to create a more supportive teacher-led or peer collaborative environment to scaffold the two tasks. Furthermore, they might want to implement the two metacognitive tasks over

a longer period of time if their students were novice learners of critical thinking. Future researchers who are interested in continuing this study may extend it by including more participants from a more diverse population, investigating the effect of the two metacognitive tasks in a longer term, changing the sequence of applying the critical thinking tags or providing professional development training for participating teachers. For the researcher, the next stage of this study will focused on three goals. First, the researcher will complete the analysis of students' online Socratic Seminars. The researcher was not able to qualitatively analyze students' online Socratic Seminar discussions in terms of the pattern and quality of critical thinking due to limited time and human resources. The researcher plans to finish the analysis in the future in order to get a different perspective on the effects of the two metacognitive tasks on students' critical thinking skills. The second goal is to modify the online forum so that students have to target a critical thinking skill(s) before they write their messages. The new online forum will also restricted each student from using limited types of critical thinking skills in order to diversify the critical thinking skills they use in their online discussions. The last goal is to obtain administrative support to extend the study and allocate more class time to help students learn critical thinking and metacognition. Based on analysis of incorrect tags in students' online posts, students seemed to have more problems with some critical thinking skills than others when they apply critical thinking tags in their online posts. This shows that students might still need more time and support to learn critical thinking skills even toward the end of the semester. In the future, if the researcher and the participating teacher can obtain more administration support to integrate the two metacognitive tasks and critical thinking training in the existing curriculum, the teacher

might have more support to help her students to learn critical thinking and get in the habit of thinking about their critical thinking while completing the two metacognitive tasks.

Appendix A: School District Institutional Review Board Approval

[ ] INDEPENDENT SCHOOL DISTRICT

Office of Accountability
Department of Program Evaluation

[ ]

August 19, 2008

Shih-Ting Lee
1304 Golden Eagle Drive
Pflugerville, TX 78660

Research Project: R09.20

Dear Ms. Lee,

This letter is to let you know that I have received all necessary forms and to notify you of the final approval of your research project entitled, *Online Learning Communities for 9th Grade World Geography and Culture Curriculum*. I've included a few comments from one of your reviewers on the next page; you may wish to take them into account as you finalize your materials and plans for data collection. You are welcome to begin data collection at the convenience of the staff at [ ]

Please remember to submit a 1-2 page executive summary of your results and a paper or electronic copy of your final report to our office when it is complete. As specified in our Access to Confidential Data Agreement, it is imperative that the anonymity of staff and students be maintained in your final report. Please feel free to contact me if you have any questions. For prompt service, please refer to the research project number above.

Sincerely,

[ ] Ph.D.
External Research Coordinator

[ ]

Reviewer comments
R09.20--Lee

Perhaps the documentation (parent and student release forms) could be more clear as to exactly what accounts in which systems the students will be creating an account. "Blogger" is mentioned repeatedly, which I believe is Google's blogging system. Parents should understand that this is a real blog on the internet, not a controlled/monitored one inside our firewall. The students will be able to interact with bloggers all over the world. [redacted] and [redacted] staff will not have control over content posted there. Perhaps it should be mentioned that the student would be agreeing to the Blogger "Terms of Service."

This is not a reason not to proceed, just a suggestion to include more specific information, maybe with actual URLs listed, of the sites that will be used.

Appendix B: University Institutional Review Board Approval

OFFICE OF RESEARCH SUPPORT

THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 (512) 471-8871 - FAX (512 471-8873)
North Office Building A, Suite 5.200 (Mail code A3200)

FWA # 00002030

Date: **09/26/08**

PI(s): **Shih-ting Lee** Department & Mail Code: **CURR & INSTRUCT DEPT** **D5700**

Dear: **Shih-ting Lee**
IRB APPROVAL – IRB Protocol # **2008-08-0094**

Title: **Online learning communities for 9th grade World Geography and Culture curriculum**

In accordance with Federal Regulations for review of research protocols, the Institutional Review Board has reviewed the above referenced protocol and found that it met approval under an Expedited category for the following period of time: **09/26/2008 - 09/25/2009**

Expedited category of approval:

___**(1)** Clinical studies of drugs and medical devices only when condition (a) or (b) is met. (a) Research on drugs for which an investigational new drug application (21 CFR Part 312) is not required. (Note: Research on marketed drugs that significantly increases the risks or decreases the acceptability of the risks associated with the use of the product is not eligible for expedited review). (b) Research on medical devices for which (i) an investigational device exemption application (21 CFR Part 812) is not required; or (ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.

___**(2)** Collection of blood samples by finger stick, heel stick, ear stick, or venipuncture as follows: (a) from healthy, non-pregnant adults who weigh at least 110 pounds. For these subjects, the amounts drawn may not exceed 550 ml in an 8 week period and collection may not occur more frequently than 2 times per week; or (b) from other adults and children2, considering the age, weight, and health of the subjects, the collection procedure, the amount of blood to be collected, and the frequency with which it will be collected. For these subjects, the amount drawn may not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and collection may not occur more frequently than 2 times per week.

___**(3)** Prospective collection of biological specimens for research purposes by Non-invasive means.
Examples:

(a) hair and nail clippings in a non-disfiguring manner;
(b) deciduous teeth at time of exfoliation or if routine patient care indicates a need for extraction;
(c) permanent teeth if routine patient care indicates a need for extraction;
(d) excreta and external secretions (including sweat);
(e) uncannulated saliva collected either in an un-stimulated fashion or stimulated by chewing gumbase or wax or by applying a dilute citric solution to the tongue;
(f) placenta removed at delivery;
(g) amniotic fluid obtained at the time of rupture of the membrane prior to or during labor;
(h) supra- and subgingival dental plaque and calculus, provided the collection procedure is not more invasive than routine prophylactic scaling of the teeth and the Process is accomplished in accordance with accepted prophylactic techniques;
(i) mucosal and skin cells collected by buccal scraping or swab, skin swab, or mouth washings;
(j) sputum collected after saline mist nebulization.

☐ **(4)** Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications). Examples:

(a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject's privacy;
(b) weighing or testing sensory acuity;
(c) magnetic resonance imaging;
(d) electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography;
(e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

___ **(5)** Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(4). This listing refers only to research that is not exempt).

_X_ **(6)** Collection of data from voice, video, digital, or image recordings made for research purposes.

_X_ **(7)** Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt).

_X_ **Please use the attached approved informed consent**

____You have been granted Waiver of Documentation of Consent
According to 45 CFR 46.117, an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

___ The research presents no more than minimal risk
AND
___ The research involves procedures that do not require written consent when performed outside of a research setting
<OR>
___ The principal risks are those associated with a breach of confidentiality concerning the subject's participation in the research **AND**
___ The consent document is the only record linking the subject with the research
AND
___This study is not FDA regulated (45 CFR 46.117)
AND
___Each participant will be asked whether the participant wishes documentation linking the participant with the research, and the participants wishes will govern.

____ You have been granted Waiver of Informed Consent
According to 45 CFR 46.116(d), an IRB may waive or alter some or all of the requirements for Informed consent if:

___ The research presents no more than minimal risk to subjects;
___ The waiver will not adversely affect the rights and welfare of subjects;
___ The research could not practicably be carried out without the waiver; and
___ Whenever appropriate, the subjects will be provided with additional pertinent information they have participated in the study.

___ This study is not FDA regulated (45 CFR 46.117)

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

(1) Report **immediately** to the IRB any unanticipated problems.

(2) Proposed changes in approved research during the period for which IRB approval cannot be initiated without IRB review and approval, except when necessary to eliminate apparent immediate hazards to the participant. Changes in approved research initiated without IRB review and approval initiated to eliminate apparent immediate hazards to the participant must be promptly reported to the IRB, and reviewed under the unanticipated problems policy to determine whether the change was consistent with ensuring the participants continued welfare.

(3) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.

(4) Insure that only persons formally approved by the IRB enroll subjects.

(5) Use **only** a currently approved consent form (remember approval periods are for 12 months or less).

(6) **Protect the confidentiality of all persons and personally identifiable data, and train your staff and collaborators on policies and procedures for ensuring the privacy and confidentiality of participants and information.**

(7) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.

(8) Submit a **Continuing Review Report** for continuing review by the IRB. Federal regulations require **IRB review of on-going projects no less than once a year** (a Continuing Review Report form and a reminder letter will be sent to you 2 months before your expiration date). Please note however, that if you do not receive a reminder from this office about your upcoming continuing review, it is the primary responsibility of the PI not to exceed the expiration date in collection of any information. Finally, it is the responsibility of the PI to submit the Continuing Review Report before the expiration period.

(9) Notify the IRB when the study has been completed and complete the Final Report Form.

(10) Please help us help you by including the above protocol number on all future correspondence relating to this protocol.

Thank you for your help in this matter.

Sincerely,

Jody Jensen, Ph.D., IRB Chair

Protocol # Approval dates: - 2008-08-0094 09/26/2008 09/25/2009

Appendix C: Teacher Consent Form

Title:

Online learning communities for 9th grade World Geography and Culture curriculum

IRB PROTOCOL #

Conducted By:

Principal Investigators
Shih-Ting Lee
Of The University of Texas at Austin: Department of Curriculum and Instruction;
Telephone: [redacted]

[redacted]
Of The University of Texas at Austin: Department of Curriculum and Instruction;
Telephone: [redacted]

Faculty Sponsor
Dr. Min Liu
Of The University of Texas at Austin: Department of Curriculum and Instruction;
Telephone: [redacted]

You are being asked to participate in a research study. This form provides you with information about the study. The person in charge of this research will also describe this study to you and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time and your refusal will not impact current or future relationships with UT Austin or [redacted] . To do so simply tell the researcher you wish to stop participation. The researcher will provide you with a copy of this consent for your records.

The purpose of this study is twofold. The first goal is to investigate how online learning communities facilitate students' development of critical thinking skills in Social Studies Curriculum. The second goal of this research is to investigate potentials of web 2.0 technologies to support global collaboration among students from different countries. Both quantitative and qualitative data will be collected to achieve these two research goals. Based on the research result, this study will also discuss suggestions for instructional design and potential technological tools for similar projects in the future.

If you agree to be in this study, we will ask you to do the following thing:

- Toward the end of the semester, the research will have an interview with you, the interview will be in your class or at a place of your convenience. It will last for about 20-40 minutes and will be audio taped. Below is a list of the interview question.

- Based on your observation, what are the impacts of this global exchange project on your students' learning of world culture and global perceptions?
- How do you feel about this global exchange project?
- How can we improve this global exchange project based on your opinions?
- What are the impacts of this global exchange on your teaching?
- What are the impacts of this online learning community on your teaching?
- How do you feel about the online discussions?
- How do you feel about students' reflections on Blogger?
- Based on your observation, what are the impacts of this online learning community on your students' learning of the subject?
- Based on your observation, what are the impacts of this online learning community on your students' development of critical thinking?
- How can we improve this online learning community based on your opinions?

Total estimated time to participate in study is during October 1st to Dec. 20th, 2008

Risks of being in the study

- This study may involve risks that are currently unforeseeable. If you wish to discuss the information above or any other risks you may experience, you may ask questions now or call the Principal Investigator listed on the front page of this form.

Benefits of being in the study include providing you useful information on designing instructional tasks and online learning communities to help your students develop critical thinking skills and learn World Geography and Culture.

Compensation:

- No compensation will be provided.

Confidentiality and Privacy Protections:

The main investigators will secure both the written and audio data in a locked closet. Only the main investigators will have access to the data after the data collection process. All the data sources will be retained until the study is complete and all the data sources have been analyzed. They will be destroyed after the research is complete.

The records of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board have the legal right to review your research records and will protect the confidentiality of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your participation call the researchers conducting the study. Their names, phone numbers, and e-mail addresses are at the top of this page. If you have questions about your rights as a research participant, complaints, concerns, or questions about the research please contact Jody Jensen, Ph.D., Chair, The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects at (512) 232-2685 or the Office of Research Support at (512) 471-8871 or email: orsc@uts.cc.utexas.edu.

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study. I consent to participate in the study.

Signature:_____ Date: _____

_____ Date: _____
Signature of Person Obtaining Consent

Signature of Investigator:_____ Date: _____

Appendix D: Parent and Student Consent Form

CONSENT ADDENDA

A. Parental Consent Form for the Participation of Children: Selected Elements

CONSENT FORM

Title:

Online learning communities for 9th grade World Geography and Culture curriculum

IRB PROTOCOL #2008080094

Conducted By:

Principal Investigators
Shih-Ting Lee
Of The University of Texas at Austin: Department of Curriculum and Instruction;
Telephone: [redacted]

Faculty Sponsor
Dr. Min Liu
Of The University of Texas at Austin: Department of Curriculum and Instruction;
Telephone: [redacted]

You are being asked to allow your child to participate in a research study. This form provides you with information about the study. The person in charge of this research will also describe this study to your child and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to have your child participate without penalty or loss of benefits to which your child are otherwise entitled. You can stop your child's participation at any time and your refusal will not impact your child's current or future relationships with UT Austin or [redacted]. To do so simply tell the researcher you wish to stop your child's participation.

The purpose of this study is twofold. The first goal is to investigate how online learning communities facilitate students' development of critical thinking skills in Social Studies Curriculum. The second goal of this research is to investigate potentials of web 2.0 technologies to support global collaboration among students from different countries. Your child will set up a Blogger account (http://Blogger.com). The Blogger is a free blogging service provided by Google. Your child will agree to the Blogger terms of service. You can review them on the Blogger.com website. The Blogger is chosen for

this project because it provides additional security features, which prevent none participants of this project to have access to students' blogs. The teacher who will teach the classes will demonstrate the accurate security settings in class. Students can also access the demonstration video created by the teacher from the teacher's website

.

Both quantitative and qualitative data will be collected to achieve the two research goals. Based on the research result, this study will also discuss suggestions for instructional design and potential technological tools for similar projects in the future.

If you agree to let your child participate in this study, we will ask your child to do the following things:

1. The main investigators will collect information about your child's level of self-regulation and critical thinking. Your child will fill out one self-regulation survey developed by Dr. Pintrich at the beginning of the semester. Your child will be asked to rate how much they agree with each statement on a scale of 1-7. One example statement from the survey is listed below.

   "When I study for a test, I try to put together the information from class and from the book."

   At the end of the semester, one critical thinking disposition survey developed by Dr. Rudd will be implemented. Your child will be asked to rate how much they agree with each statement on a scale of 1-5. One example statement from the survey is listed below.

   "I listen carefully to the opinions of others even when they disagree with me."

2. Toward the end of the semester, the researchers will also interview your child individually if you grant the permission. The interview will be during lunch hours in the classroom when the teacher is present. It will be audio taped and should take about 20 minutes. The interview questions are listed below.

   1-1 How do you feel about this global exchange project?
   1-2 How do you feel about Blogger?
   1-3 How can we improve this global exchange project based on your opinions?
   1-4 How do you feel about the online Socratic Seminar?
   1-5 How do you feel about the content management system?
   1-6 How do you feel about the tags in the discussion forum?
   1-7 How do you feel about the reflections on Blogger?
   1-8 How do you feel about the online community?
   1-9 How can we improve the online learning community based on your opinions?

Total estimated time to participate in study is from October 1st to Dec 20th, 2008
Risks of being in the study

- This study may involve risks that are currently unforeseeable. If you wish to discuss the

Benefits of being in the study include several educational advantages. They are listed below

- -Leaning World Geography and Culture using computer and Internet
- -Gain global perspectives through interactions with peers from abroad.
- -Apply critical thinking skills in course activities
- -Receive social and intellectual support from the instructor and peers

Compensation:

- Your child will not be compensated.

Confidentiality and Privacy Protections:

The main investigators will secure both the written and audio data in a locked closet. Only the main investigators will have access to the data after the data collection process. All the data sources will be retained until the study is complete and all the data sources have been analyzed. They will be destroyed after the research is complete.

The **records** of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board have the legal right to review your child's research records and will protect the **confidentiality** of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify your child as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your child's participation call the researchers conducting the study. Their names, phone numbers, and e-mail addresses are at the top of this page. If you have questions about your child's rights as a research participant, complaints, concerns, or questions about the research please contact Jody Jensen, Ph.D., Chair, The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects at (512) 232-2685 or the Office of Research Support at (512) 471-8871.or email: orsc@uts.cc.utexas.edu.

You may keep the copy of this consent form.

You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. If you later decide that you wish to withdraw your permission for your child to participate in the study, simply tell me. You may discontinue his or her participation at any time.

_____
Printed Name of child

_____ _____
Signature of Child Date

_____ _____
Signature of Parent(s) or Legal Guardian Date

_____ _____
Signature of Investigator Date

B. Assent form for child between 13 and 17 years of age

"I have read the description of the study titled Online learning communities for 9th grade World Geography and Culture curriculum that is printed above, and I understand what the procedures are and what will happen to me in the study. I am aware of the services provided by the school counselor. If I feel distressed while participating in the study, I will contact the school counselor, [ ]. I have received permission from my parent(s) to participate in the study, and I agree to participate in it. I know that I can quit the study at any time."

_____ _____
Signature of Child Date

Appendix E: Critical Thinking Training Handout for All Participants

In this training, we will address several topics related to critical thinking. Below is list of the topics and their sequence.

1. What is critical thinking based on your opinion?
2. What is critical thinking based on experts' opinion?
3. What kind of person can be considered a critical thinker?
4. Why critical thinking important to your learning of World Geography and Culture?
5. What are some of the critical thinking skills and what do they mean?
6. How can we use critical thinking in this class?

Experts define a critical thinker as someone who is

> habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results. (Facione, 1990, p. 9)

A critical thinker also constantly applies critical thinking skills, which is composed of a set of skills as listed below. You are encouraged to apply as many of the skills as possible in this class.

Critical Thinking Skills

Interpretation

identifies the main purpose

articulates divergent points of view

categorize information

summarizes main ideas

paraphrases in my own words

Analysis

identifies relationships among statements, concepts, judgments and opinions

detects arguments supporting and contesting points of view

identifies biases

identifies unstated assumptions

distinguishes relevant from irrelevant points of view

Evaluation

assesses credibility of the evidence

assesses credibility of points of view and opinions

raises questions or objections (to discover weaknesses in an argument)

offers supplementary information (that may strengthen or weaken an argument)

Inference

derives plausible conclusions (from the given information)

makes a logical recommendation (not questions) for action

gives recommendations for further inquiry

identifies potential consequences

Explanation

demonstrates breadth and depth of information

communicates clearly, accurately and precisely

uses relevant information to support my opinion

logically communicates in a structured form

Self-Regulation

demonstrates self-questioning and self-validation

recognizes my own need for further inquiry

reflects upon and justifies own thinking process

identifies personal biases

Appendix F: Training Handouts for critical thinking tags for the Online Socratic Seminar in the Experimental Group

Below is an excerpt of online Socratic Seminar Discussions from Spring, 2008, they are direct quotes from the original except elimination of names. Based on the critical thinking handouts you received earlier, please work in pairs or groups of 3-4 people to decide, what kind of critical thinking skills these messages demonstrated. Please refer to the list of critical thinking skills and write down any critical thinking skills that are demonstrated in each post in the label section below each post, for example.

Example Post:
"i would also agree with you, i did read that article and found out an interesting fact on population growth "Rapid population growth commenced not because human beings suddenly started breeding like rabbits but rather because they finally stopped dying like flies." i also learned that population is not the problem that causes hunger but restricting governments like the one in china."

LABEL: Stating research results , Changing conclusion in the light of new evidences

Practice posts:

Online Socratic Seminar Topic: One Child Policy in China

Discussion Thread 1
Initial Question
"In China they have implmented a one child policy to controll the population. Since then there has been a growing population of more boys than girls according to th {National Geographic Video}. The policy in my oppinion is a good policy but the people who are cheating it I think are bad. In the National Geographic Video people are aborting there girls cause they beliive that they are useless . In my oppinion the only solution is to educate the Urban areas of china and the citys to help them understand that if this behavior keeps going the way its going they could face a huge tragedy in the future."

LABEL: _____

Reply 1
“I agree 100%. The policy would probably work but to many people are disobeying it and so it's not working. They are also becoming greedy and want boys since boy's help the family and girls are no help at all. Not only that but mothers who are having more than one baby and can't afford the fines are being forced to send their babies away. In the "Babies for sale..." article it says "As a mother, I really want to watch her grow every day with me. But I know that's not possible. It's sad that the families have to give their babies away but on the other side of it, they shouldn't have had the second or third baby to begin with. The policy is there already and the people should obey it whether or not it's right.”

LABEL: _____

Reply 2
“I Agree! If the Urban areas of China do not get on bord with the policy they could face the future with middle age men seeking women. Acoording to the video women get abortions even before their fist child is born to make sure it is a boy. The boy carries on the family name. Like you said, they need to stop that! In some areas of China i believe they need to figure a way to make abortion not allowed. It might sound strange since ther are so many people, however it may lead the nation to having more girls.”

LABEL: _____

Reply 3
“I think that this is a good idea but I think it will not work. just because there is such a preference for boys. in the video it said "that the sister of one of the women that talked to the video had gotten rid of the first child because it was a girl. this shows me that it is enbeded in the mines of the people that boys are good, for that reason they will not change there views.”

LABEL: _____

Discussion Thread 2
Initial Post
“There is a recent earthquake in China, which results in thousthands of death. Many of the victims are the only child in the Family. MSNBC has a report on how the One Child Policy causes extra pain to the families http://www.msnbc.msn.com/id/24671025/. Even though the One Child Policy has been an effective way to control the population in general, in the face of tragedies such as this, it is also equally important to discuss it's impact on individuals. After taking into account all the pros and cons of implementing the One Child Policy in China, do you think China should continue it, implement other alternative policies or discontinue it?”

LABEL: _____

“I think that china should continue its one child policy but it should also educate its people so that there would be an equal amount of boys and girls. i think this because in the late fifties and early sixties 20 to 43 million people died of starvation, also in some areas one in every four people died of starvation (China's One Child Policy). I also think this practice should be started in other areas of the world with soaring populations so starvation and other population related problems are slowed down.”

LABEL: _____

“Can't agree with you more on educating Chinese people on the equal benefits of having boys and girls. However, overpopulation might be the main or only cause of startvation in the late fifties and early sixties, but propably not any more in this century. Jeff Lindsay's article on
"Is Human Population really the problem?" (http://www.jefflindsay.com/Overpop.shtml) did a great job examining the general misconception on startvation and overpopulation. Here is a brief quote from his article
"The population doomsayers usually offer the solution of global government - BIG government - to determine, in Gaylord Nelson's words, "the optimum number of people." Ironically, where there is famine, the problem usually is not an excess of people but an excess of government, which leads to gross misallocation and misuse of resources as corrupt bureaucrats or dictators seek power more than the welfare their subjects. "”

LABEL: _____

Appendix G: Self-Regulation Survey

Below is a series of statements concerning your self-regulated learning strategies. There is no right or wrong answer. Please work quickly and record your first impression by indicating the degree to which you agree or disagree with the statement. Thank you so much for your cooperation.

1 2 3 4 5 6 7

not at all true of me very true of me

____1. When I study for a test, I try to put together the information from class and from the book.

____2. When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly.

____3. It is hard for me to decide what the main ideas are in what I read.

____4. When I study I put important ideas into my own words.

____ 5. I always try to understand what the teacher is saying even if it doesn't make sense.

____6. When I study for a test I try to remember as many facts as I can.

____7. When studying, I copy my notes over to help me remember material.

____8. When I study for a test I practice saying the important facts over and over to myself.

____9. I use what I have learned from old homework assignments and the textbook to do new assignments.

____10. When I am studying a topic, I try to make everything fit together.

____11. When I read material for this class, I say the words over and over to myself to help me remember.

____12. I outline the chapters in my book to help me study.

____13. When reading I try to connect the things I am reading about with what I already know.

____14. I ask myself questions to make sure I know the material I have been studying.

____15. When work is hard I either give up or study only the easy parts.

____16. I work on practice exercises and answer end of chapter questions even when I don't have to.

____17. Even when study materials are dull and uninteresting, I keep working until I finish.

____18. Before I begin studying I think about the things I will need to do to learn.

____19. I often find that I have been reading for class but don't know what it is all about.

____20. I find that when the teacher is talking I think of other things and don't really listen to what is being said.

____21. I find that when I am reading I stop once in a while and go over what I have read.

____22. I work hard to get a good grade even when I don't like class.

____23. I often find myself questioning things I hear or read in this course to decide if I find them convincing.

____24. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.

____25. I treat the course material as a starting point and try to develop my own ideas about it.

____26. I try to play around with ideas of my own related to what I am learning in this course.

____27. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.

Appendix H: Critical Thinking Disposition Survey

Below is a series of statements concerning your critical thinking disposition. There are no right or wrong answers. Please work quickly and record your first impression by indicating the degree to which you agree or disagree with the statement. Thank you for your cooperation.

5 = strongly agree

4 = agree

3 = uncertain Please put the number corresponding to your answer in the

2 = disagree blank before the statement

1 = strongly disagree

____1. I listen carefully to the opinions of others even when they disagree with me.

____2. I look for opportunities to solve problems.

____3. I am interested in many issues.

____4. I enjoy learning about many topics.

____ 5. I am able to relate to a wide variety of issues.

____6. I ask lots of questions in a learning environment.

____7. I enjoy finding answers to challenging questions.

____8. I am a good problem solver.

____9. I am confident that I can reach a reasonable conclusion.

____10. I strive to be well informed.

____11. I am likely to change my opinion when I am given new information that conflicts with my current opinion.

____12. I enjoy solving problems.

____13. I try to consider the facts and not let my biases affect my decisions.

____14. I am able to apply my knowledge to a wide variety of issues.

____15. I enjoy learning even when I am not in school.

____16. I can get along with people who do not share my opinions.

____17. I am able to explain things clearly.

____18. I ask good questions when trying to clarify a solution.

____19. I present issues in a clear and precise manner.

____20. I consider how my own biases affect my opinions.

____21. I search for the truth even when it makes me uncomfortable.

____22. I keep on working on things until I get them right.

____23. I will go out of my way to find the right answers to a problem.

____24. I try to find multiple solutions to problems.

____25. I ask many questions when making a decision.

____26. I believe that most problems have more than one solution.

Appendix I: Opinion Survey for the Comparison Group

Your Opinion

Your opinion means a lot to us. It will help us to improve this project in the future. Please let us know how you think about the online activities and how we might be able to improve it. Thank you so much for your help!

1. How do you think about the online Socratic Seminars? Any suggestions to improve it?

Appendix J: Opinion Survey for the Experimental Group

Your opinion means a lot to us. It will help us to improve this project in the future. Please let us know how you think about the online activities and how we might be able to improve it. Thank you so much for your help!

1. How do you think about the online Socratic Seminars? Any suggestions to improve it?

2. How do you think about the critical thinking tags you used in the online Socratic Seminars?

3. How do you think about the reflection journals for each Socratic Seminar topics?

Appendix K: Score Sheet for Critical Thinking Skill Report Rubric

Score Sheet for Critical Thinking Rubric

Student's Name: _____ Class/Semester: _____

Interpretation: *Total Score:* _____

The writer correctly identifies the main purpose. _____

The writer articulates divergent points of view. _____

The writer attempts to categorize information. _____

The writer summarizes main ideas or paraphrases in their own words. _____

Analysis: *Total Score:* _____

The writer identifies relationships among statements, concepts, judgments and opinions.

_____

The writer detects arguments supporting and contesting points of view. _____

The writer distinguishes relevant from irrelevant points of view. _____

The writer identifies biases and unstated assumptions. _____

Evaluation: *Total Score:* _____

The writer assesses credibility of the evidence. _____

The writer assesses credibility of points of view and opinions. _____

The writer raises questions or objections to discover weaknesses in an argument. _____

The writer offers supplementary information that may strengthen or weaken an argument.

_____

Inference: *Total Score:* _____

The writer derives plausible conclusions from the given information. _____

The writer makes a logical recommendation (not questions) for action. _____

The writer gives recommendations for further inquiry. _____

The writer identifies potential consequences. _____

Explanation: *Total Score:* _____

The writer demonstrates breadth and depth of information. _____

The writer communicates clearly, accurately and precisely. _____

The writer uses relevant information to support their opinion. _____

The writer logically communicates in a structured form. _____

Self-Regulation: *Total Score:* _____

The writer demonstrates self-questioning and self-validation. _____

The writer recognizes their own need for further inquiry. _____

The writer reflects upon and justifies own thinking process. _____

The writer identifies personal biases. _____

Total Score: _____

Appendix L: Online Socratic Seminar Discussion Guideline for the Experimental Group

***** Very Important: Always use valid references to support your claim.**
*****Don't forget to add the tags**

For this discussion,

1. You will post AT LEAST one message/question based on credible source and reply to two others' by extending their ideas.

2. Every time you post a new question that is related to the topic, make sure you add that question in a new thread.

3. ALWAYS add critical thinking tags beneath your post. Select the ones that apply to your post from the list of tag below.

Critical Thinking Tags

Interpretation

identifies the main purpose

articulates divergent points of view

categorize information

summarizes main ideas

paraphrases in my own words

Analysis

identifies relationships among statements, concepts, judgments and opinions

detects arguments supporting and contesting points of view

identifies biases

identifies unstated assumptions

distinguishes relevant from irrelevant points of view

Evaluation

assesses credibility of the evidence

assesses credibility of points of view and opinions

raises questions or objections (to discover weaknesses in an argument)

offers supplementary information (that may strengthen or weaken an argument)

Inference

derives plausible conclusions (from the given information)

makes a logical recommendation (not questions) for action

gives recommendations for further inquiry

identifies potential consequences

Explanation

demonstrates breadth and depth of information

communicates clearly, accurately and precisely

uses relevant information to support my opinion

logically communicates in a structured form

Self-Regulation:

demonstrates self-questioning and self-validation

recognizes my own need for further inquiry

reflects upon and justifies own thinking process

identifies personal biases

Grading Rubric for Student Online Socratic Seminar Discussions

Category	Criteria
Your Post	**5 points** - Post at least one message/question in the discussion forum and your message was based on a credible reference -Add appropriate critical thinking tags **3 points** - Post at least one message/question in the forum without citing credible reference -Add irrelevant or inaccurate critical thinking tags **0 points** - No contribution at all
Your Comments	**5 points** - Reply to at least 2 others' post in the discussion forum and extend other's ideas -Add appropriate critical thinking tags **3 points** -Reply to two other students' post, but didn't extend their ideas or only extend to one of their ideas. -Add irrelevant or inaccurate critical thinking tags **2 points** - Reply to another students' post in the discussion forum without extending other's ideas **0 points** -No feedbacks at all
Bonus Points	You will receive 2 extra bonus points with every extra post or comment.
Total (10 points) & bonus	

Appendix M: Online Socratic Seminar Discussion Guideline for the Comparison Group

***** Very Important: Always use valid references to support your claim.**

For this discussion,

1. You will post AT LEAST one message/question based on credible source and reply to two others' by extending their ideas.

2. Every time you post a new question that is related to the topic, make sure you add that question in a new thread.

Grading Rubric for Student Online Socratic Seminar Discussions

Category	Criteria
Your Post	**5 points** - Post at least one message/question in the discussion forum and your message was based on a credible reference **3 points** - Post at least one message/question in the forum without citing credible reference **0 points** - No contribution at all
Your Comments	**5 points** - Reply to at least 2 others' post in the discussion forum and extend other's ideas **3 points** -Reply to two other students' post, but didn't extend their ideas or only extend to one of their ideas. **2 points** - Reply to another students' post in the discussion forum without extending other's ideas **0 points** -No feedbacks at all
Bonus Points	You will receive 2 extra bonus points with every extra post or comment.
Total (10 points) & bonus	

Appendix N: Reflective Journal

Guideline of Reflective Journal after Each Online Socratic Seminar Discussion

Please briefly answer each question. After you finish them please return this sheet to the teacher.

1. How confident are you in that you have found a good solution to the problem? Why?

2. What was the most useful to you in solving the problem?

3. After learning more about the issue, how has or has not your initial stance on the issue changed? What possibly caused the changes?

4. If your stance changed, what do you think about the change?

5. If your stance doesn't change, what do you think about it?

6. If your initial stance changed, do you think it might change again in the future in light of newer information? Why?

7. What do you think about yourself in regard to critical thinking?

Appendix O: Pretest Critical Thinking Skill

Writing Assignment

During this semester, you are going to learn and discuss two current event topics

(1) How can our country deal/help with illegal immigrants?

(2) How can our country protect civil rights in the face of terrorist attacks?

Please select one question out of the two questions above and explain how you propose to solve them. Please elaborate on your rationale.

Appendix P: Posttest Critical Thinking Skill

Writing Assignment

During this semester, you have learned and discussed two current event topics

(1) How can our country deal/help with illegal immigrants?

(2) How can our country protect civil rights in the face of terrorist attacks?

Please select one question out of the two questions above and explain how you propose to solve them. Please elaborate on your rationale.

Appendix Q: Student Interview Protocol

1. What do you think about the online Socratic Seminar?
2. What do you think about the content management system?
3. What do you think about the online environment?
4. How can we improve the online environment based on your opinions?
5. How does the teacher introduce the critical thinking skills

For students in the experimental group only

6. What do you think about the critical thinking tags
7. How does the teacher introduce the critical thinking tags?
8. What do you think about the reflection?

Appendix R: Teacher Interview Protocol

1. What do you think about the online environment created for your class this semester?
2. What do you think about the online Socratic Seminars?
3. What do you think about the critical thinking tags?
4. How do you introduce the critical thinking tags?
5. What do you think about students' reflection?
6. Based on your observation, does this online learning environment have any impact on your students' learning of the subject? If yes, in what way?
7. Based on your observation, does this online learning environment have any impact on your students' development of critical thinking? If yes, in what way?
8. How can we improve this online learning environment based on your opinions?
9. How can we improve the online Socratic Seminars based on your opinions?

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